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# Recommendations for Mosquito Control Programs in Tennessee
## County Director's Meeting
## West Nile Virus: Mosquito Control Issues
## Renaissance Center, Dickson, Tennessee
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The primary purpose of this document it to dispel some generally held myths about mosquito control and inform you of the current professionally accepted methodology in this field. This document was compiled from professionally reliable resources such as the EPA, CDC, AMCA (American Mosquito Control Association) and New Jersey/Florida mosquito recommendation guidelines. New Jersey and Florida mosquito control associations are universally recognized as reliable sources of information by the entomological community as well as by the CDC. The information they produce is considered the gold standard that all mosquito control programs should uphold to maintain a sustainable and responsible mosquito control program. Responsible mosquito control programs should be rooted in true entomological principles without the influence of other non-professional agendas that will in time degrade the professional reputation of a program. This information is not original thinking on my part, but is information that has been compiled from numerous sources and presented as it pertains to Tennessee. The primary goal of this document and formal presentation is to strongly encourage locally funded mosquito control programs (existing and start-up) to re-design or design a program that is not only effective at reducing the mosquito burden, but to accomplish that goal by using universally accepted standards of mosquito control methodology.

## FUNDING of Mosquito Control Programs Statewide:

The State of Tennessee has never funded any type of mosquito control program. All existing or future programs are funded entirely by locally generated taxes. The only role of the Tennessee Department of Health in regards to mosquito control is to provide consultation by a formally trained entomologist to any organizations that request advice or information concerning these issues.

## BACKGROUND:

Acceptable insect control (crop and public health insects) practices have changed dramatically since the end of WWII to the present. The following paragraphs will present a brief history of the events that were instrumental in the development of professionally accepted insect control strategies over the last 4 decades.

DDT was first synthesized in 1874 but its effectiveness as an insecticide was not discovered until 1939. The United States used the insecticide during World War 11 for the protection of troops stationed oversees against typhus and malaria outbreaks. After the war, DDT was used world wide for the control of vector-borne diseases and crop pests. The most desirable characteristic of DDT at the time was the ability of the product

to persist in the environment meaning that the product maintained its effectiveness long after application. The popularity of the product eventually declined due to increased insect resistance in the insect populations, the development of more effective alternative pesticides, a growing public concern over adverse environmental side effects and the increasing government restrictions on DDT use. www.epa.gov

Meanwhile, the Environmental Protection Agency was slowly evolving from an idea in the Nixon Administration in 1969 to an independent agency of the federal government in 1972. The motivation to establish the EPA was pressured by the growing public concern over adverse environmental effects fueled by Rachel Carson's book, Silent Spring, published in 1962. On December 13, 1973, the US Court of Appeals for the District of Columbia ruled that there was "substantial evidence" in the record to support the EPA Administrator's ban on DDT. The mission of the EPA is to protect human health and to safeguard the natural environment-air, water, and land- upon which life depends. For 30 years, EPA has been working for a cleaner, healthier environment for the American people. www.epa.gov

Over the last couple of decades, acceptable mosquito control practices in the US have evolved from a total reliance on adulticide use for control of adult mosquitoes (reactionary mosquito control program) to an integrated pest management approach to mosquito control. The primary effect of an integrated approach is that adulticide use should decrease significantly and that the use of more effective methods should increase significantly. The task of educating political officials and the general public on why there will no longer be a truck that disperses adulticides in their neighborhoods on a regular basis is a formable task but in the long run will result in a more effective control program and will reduce the pesticide burden on the public and environment.

## INTEGRATED PEST MANAGEMENT

### What is IPM as it pertains to organized mosquito control and why do we use this approach?

Integrated Pest Management (IPM) or sometimes called Integrated Mosquito Management (IMM) as it pertains to organized mosquito control is defined as: A sustainable approach to managing mosquitoes by selecting the best combination of control strategies (mosquito surveillance, source reduction/prevention, larviciding, biological control, public education and adulticiding (only when and if necessary)) in a way that prevents unacceptable levels of mosquitoes by the most economical means and with the least possible hazard to people, property, and the environment.

No EPA-approved adulticide is 100% safe. For this reason, the EPA carefully regulates pesticides to ensure that their use does not pose unreasonable risks to human health or the environment. In particular, the federal pesticide program is designed to ensure that these products can be used with a reasonable certainty that they will pose no harm to infants, children, and adults. www.epa.gov Of course, EPA-approved pesticides are approved for treatment when used following detailed and specific application procedures clearly stated on the product labels. It is necessary to ensure that all applicators are trained to apply the product per label instructions.

It is NOT possible to eradicate mosquitoes: No matter what amount of monetary or personal resources are invested in a mosquito control program, it is NOT possible to eradicate mosquitoes. Even if a city or county effectively treats every known larval production site in their jurisdiction, individual citizens will continue to have small containers on the back porch that will produce adult mosquitoes. The only way to reduce those production sites is to plead with citizens to participate in the program by reducing/eliminating standing water on private property. In addition, mosquitoes know no jurisdictional boundaries and flight ranges vary greatly in all species. Some mosquito species fly miles from the larval habitat to procure a blood meal. Municipal spray programs will only kill mosquitoes that are found in the treatment area at the time of treatment. The actually breeding site, where the majority of adults would be found, may not be in the treatment area and adults will quickly move into the treatment area.

Need qualified personnel to manage a mosquito control program: Not everyone is qualified or capable of managing a municipal mosquito control program. Moving unqualified people from other areas in the local government into a control program is not a good foundation for a reputable program. Although there may be good intentions by all parties involved, diverting personnel without prior knowledge of accepted mosquito control practices will not be to the benefit of a successful and reputable program. At the minimum, the mosquito control program manager should have prior knowledge of common entomological practices or be able to be professionally trained and willing to adjust the program based on accepted mosquito control practices.

**Why it is professionally unacceptable to use adulticides as the only strategy or the primary strategy in a mosquito control program.**

Adulticiding without the use of other effective methods is not only ineffective and expensive but even more importantly, may be considered deceptive because it implies to citizens that everything is safe and personal precautions are not necessary.

There are special circumstances that may require wide spread adulticiding (for example; many square miles of flooding with standing water lasting for weeks) but those situations are rare and would likely require aerial application due to the size of the treatment area for the purpose of reducing nuisance mosquito populations. Even in these situations, reputable mosquito control programs would attempt to control mosquito populations with other more effective measures prior to moving directly to the use of adulticides.

With the exception of special situations as stated above, there are other reasons why a program might only use adulticiding as the primarily control method of choice:

a. The mosquito control manager is uniformed about professional standards of mosquito control methods and has not been trained properly or is unwilling to change practices.

b. The program is severely under-funded.

1. Program was initially developed in response to citizen demands void of appropriate funding.
2. Even with the best intentions, two people cannot appropriately cover an entire metro region and may be forced to adulticide.

c. The manager is only doing what the majority of citizens want to see done and not following professionally acceptable guidelines.

d. There is intense political pressure placed on mosquito control programs from elected officials to do what constituents expect.

## Adulticiding as the only control source is ineffective for the following reasons:

1. There are approximately 170 different mosquito species found in the US and approximately 50 mosquito species found in Tennessee. All mosquito species found in Tennessee are not pests nor do they feed on humans nor are they WNV vectors. Even though there is a list of mosquito species that have been found with evidence of WNV contact in the US, very few of those species are biologically capable of serving as effective WNV vector species.

There are three primary mosquito species in Tennessee that are involved in WNV transmission to humans and are all in one genus: *Culex*. If a program is designed specifically to reduce the mosquitoes that are involved in WNV transmission, then the program must be specific and targeted for the mosquitoes in the genus *Culex*. I say this to convey the critical point that an effective program must specifically target the species present in the area. Since, eradicating mosquitoes is not possible, an acceptable level of mosquitoes must be determined. Once the mosquito species are identified, the knowledge of flight, biting and breeding behavior will allow the program to apply adulticides effectively. The bottom line is that the application of adulticides without regular mosquito surveillance (knowledge of the target species) may look pleasing to the average citizen, however, it is ineffective and can potentially lead to serious consequences.

2. Adulticides are designed to break down fast in the environment; there are NO residual effects of the product. Product droplets that land and dry on surfaces will not kill mosquitoes landing on that surface. Adulticides must come in direct contact with a flying mosquito to kill; mosquitoes that are in inaccessible habitats will not be affected. The appropriate timing of the adulticidal application is based on knowing the mosquito species present in the area as well as the behavioral (feeding, breeding) characteristics.

3. Adulticides will only kill flying adult mosquitoes that are in the area at the time of application and may supply short-term relief (3-4 days). The immature stage (larvae) found in water sources will NOT be affected. When the next generation of mosquitoes emerges from the water surfaces, there is an entire new population that will need to be treated. In addition, some mosquito species are capable of flying long distances in search of a blood meal; treatment in one area will not prevent searching mosquitoes from another area entering the treatment area after application.

4. Overuse and non-regulated use of chemical products used for adulticiding or larviciding have the potential to increase the resistant individuals in a population. Once resistant individuals increase in a resident mosquito population, killing the adults becomes increasingly difficult. Resistance occurs when a mosquito population is treated with a chemical product and although a substantial proportion may die, there will be a few that have the capability of reducing the chemical to inert compounds with no biological effects. Survivors will be capable of passing on these favorable genetic characteristics to their progeny and essentially an artificial selection process will produce a resistant population.

Since adulticidal products are expensive, the natural thought would be to most operators to decrease the concentration for the purpose of reducing cost. This is a great mistake and actually results in encouraging the development of a resistance mosquito population. The application of less concentrated products will not provide a lethal dose and will result in a mosquito population with resistant individuals. Resistant individuals will build up in a population with each additional application of decreased concentration. There are very few EPA registered adulticidal products on the commercial market. Promoting resistant populations in a region will only decrease the effectiveness of these few products. Then during an unfortunate time if/when a critical public health situation arises, the products of choice will be limited and success questionable.

5. There are non-chemical strategies available for use in many situations and the EPA recommends considering using these methods as part of an overall pest management strategy, IPM. Therefore, adulticides should play only a small roll in the overall mosquito control program.

IF A REGION IS GOING TO INVEST LOCAL FUNDS INTO A MOSQUITO ABATEMENT PROGRAM-THEN THE PROGRAM SHOULD BE FUNDED SUFFICIENTLY TO ENSURE COMPLIANCE WITH PROFFESSIONALLY ACCEPTED MOSQUITO CONTOL STANDARDS.

## Why is public education that results in behavioral changes important?

Public education is a critical component of any vector control program. It can be very effective if the public is willing to turn knowledge into behavioral changes. Individuals in the community can significantly reduce their chances of infection by taking personal protective measures. Personal protective measures include staying indoors when mosquitoes are most active (early morning and early evening), using insect repellants containing DEET (i.e. 35% DEET for adults, 10-15% DEET for children over 10 months of age) per label instructions and wearing appropriate clothing that provides a physical barrier against mosquito bites. Individuals can significantly reduce mosquito activity near their homes if breeding sites are reduced or eliminated around their homes. No amount of investment into a community wide mosquito control program will prevent mosquitoes from breeding on an individual citizen's back porch in a flower pot dish. Mosquitoes that emerge from standing water in a person's backyard generally stay in the vicinity for blood meals. For this reason, the general public can help tremendously in the mosquito control effort.

It may be prudent to focus public education efforts to the older age groups. As we have seen from five years of human disease, people of all ages are capable of being infected but older people are more vulnerable to infection with WNV in that it will cause more severe effects than in younger age groups. Statistically, the chances of being infected with WNV and developing the severe form of the disease increases with age.

## Responsible mosquito control programs have four elements?

**1. MOSQUITO SURVEILLANCE**: The mosquito surveillance component of a program provides a way to target the mosquito species (pest and vector) of concern and also provide evidence that supports the justification for selected control measures. Species specific records should be kept on the composition of mosquito populations, prior to enacting control measures of any type. It is equally important to maintain records on the species

composition after control measures have been performed to ensure that the measures were effective at reducing the mosquito population to acceptable levels. There are numerous mosquito surveillance methods that must be employed to have a comprehensive surveillance program.

**Larval Surveillance**: Larval surveillance involves sampling a wide range of aquatic habitats for the presence of mosquitoes during the developmental stages. There should be a team of inspectors (full time or temporary employees) to collect larval specimens on a regular basis from these sites. Mosquito identification specialist can separate mosquito species that cause nuisance and disease from those that are non-pests or beneficial species. Responsible control programs target pest populations for control based on evidence and avoid managing habitats that supports benign species. It is necessary to invest in properly trained personnel who are capable of reliable identifying larval specimens.

**Adult Surveillance**: Adult surveillance measures mosquito populations that have successfully developed and emerged from aquatic habitats. Adult mosquitoes should be trapped by a variety of methods because all mosquito species are not attracted to all trapping methods. There area variety of trapping methods available and all are necessary to ascertain the true picture of mosquito species that are present. For example, if only one type of trapping method is used for surveillance, then the mosquito species that are attracted to that type of trap will be collected. The data collected will not be a valid picture of the situation. Using a variety of trapping methods will give the program manager the total picture of species in the area and provide valuable information to determine the best control measures available for the situation. Personnel assigned to perform this task must be properly trained in mosquito collection methods and must be capable of reliable identifying adult mosquitoes to species.

**Virus Surveillance:** Measures the size of the vector population and tests specimens for the presence of virus on a regular basis. In specific situations, mosquito specimens can be tested by the Tennessee Department of Health State Laboratory by polymerase chain reaction (PCR) technology for evidence of WNV. This information will allow the program manager to calculate minimum infection rates in the mosquito population which is useful in determining the potential public health threat levels. Once again, proper funding is a requirement because trained personnel need to be capable of reliable identifying mosquitoes to species and preparing specimens for laboratory submission per specific protocol instructions.

**2. SOURCE REDUCATION** Source reduction is the alteration or elimination of mosquito larval habitat which results in permanent control. This remains the most effective and economical method of providing long-term mosquito control. Source reduction can include activities ranging from the removal of used tires, removing leaves from clogged rain gutters, and periodically cleaning bird baths by individual property owners, to extensive regional water management projects. All of these activities eliminate or substantially reduce mosquito breeding sites and the need for repeated applications of insecticides in the affected habitat.

**Sanitation:** The by-products of the activities of humans have been a major contributor to the creation of mosquito breeding habitats. An item as small as a bottle cap or as large as the basement of a demolished building can serve as a mosquito

breeding area. Sanitation is a major part of all IPM programs exemplified by tire removal, de-snagging waterways, catch basin cleaning and container removal.

In most communities, the public does not have the right to produce or harbor public-health pests. When a business or homeowner fails to correct a mosquito breeding problem area, the local control agency usually has the authority to enter the property and inspect the premises to evaluate the situation. If the agency deems that the situation impacts on other residents in the area, it can take action to enforce compliance or to mitigate the problem. Improper waste-tire disposal frequently requires such intervention. I have found that metropolitan areas have public health ordinances as well as fines associated with the ordinances for non-compliance. In rural areas, there may or may not be public health ordinances and no fines associated with non-compliance. In these situations, asking the property owner to comply may be the only option, with compliance by the homeowner optional.

**Storm Water Retention/Detention Sites**. Occasionally, local circumstances intensify public-health problems. For example, in most communities the control of storm water drainage is not the responsibility of public health pest control agencies. Inevitably, however, storm water management areas and reconstructed wetlands that have been designed without guidance from public health pest control agencies tend to become significant sources of pest mosquitoes. When control agencies are invited to share in the planning, problems can be avoided at the onset, and the resulting budgetary commitments to such breeding source can be minimized.

a. Retention Ponds are associated with developmental sites where rain water gathers for the prevention of flooding. These areas are designed by developers and plans approved by other local organizations. The ponds are designed to hold water for no more than 72 hours but often these areas hold water for a longer period of time which makes them prime breeding habitats:

The reasons why retention ponds hold water more than 72 hours may be due to the following:

1. Retention Pond was not properly designed and built to specification from the beginning (example: elevation incorrect that prevent drainage)
2. Retention Ponds are not properly maintained by cleaning out drainage area to allow for proper removal of water. Regular maintenance and observation is required to ensure these sites are operational.

Both of these problems are preventable.

b. Catch basins: Catch basins are concrete basins under the streets that divert rain water to tunnels designed for the prevention of flooding. These structures require regular attention to ensure that the basins are not clogged with trash, which prevents the proper removal of water. Clogged catch basins have great potential as breeding sites for the production of large numbers of disease vectors in residential and commercial areas. In many communities, attention to catch basins represents a full-time commitment in order to prevent mosquito-related problems. Proper maintenance of these structures will allow run-off water to continue moving and control measure will not be necessary.

**3. CHEMICAL CONTROL MEASURES**: In habitats, where source reduction is not possible or feasible, chemicals can be used judiciously to control both immature mosquito populations and adult populations.

**Larviciding**: Larviciding, the application of chemicals to kill the immature stages of mosquitoes by ground or aerial treatments, is typically more effective and target specific than focusing on adults. The objective is to target the immature stage of the mosquito lifecycle at the breeding habitat before adults have emerged and dispersed over a large area. Applications for larvicides encompass fewer acres than adulticides because treatments are made to relatively small areas where larvae are concentrated as opposed to larger regions where adults have dispersed. Larvicides used for mosquito control are *Bacillus thuringiensis israelensis* and *Bacillus sphaericus* (bacterial larvicides), methoprene (insect grown regulator), temephos (organophosphate) and petroleum based oils. The advantage of this control method is targeting immature mosquitoes in a relatively concentrated area with little non-target effects on other organisms. There are environmental concerns with the use of some products for larval habitats and thus they should be used judicially. Petroleum based oils increase the surface tension of the water and do not allow surface breathing organisms to penetrate the surface, and thus organisms suffocate. There are beneficial insects that are will be affected by these products such as predatory aquatic beetle larvae and beetle adults which feed on other aquatic insects including mosquito larvae.

**Adulticiding:** Adulticiding is the use of chemicals to reduce adult mosquitoes by ground or aerial applications. Adulticiding should only be used when all other less invasive control measures have failed to reduce mosquito populations to an acceptable tolerance and there is documented evidence to sufficiently support the measure. Feelings, perceived threats and public hysteria are NOT considered acceptable documented evidence to support adulticiding measures. See page 1 for additional information. Possible adulticides of use are pyrethroids and malthion (organophosphate). All application sites should be monitored before and after treatment to ensure proper placement and effective control.

**Chemical Drift and Chemically Sensitive Individuals.** Public health insecticides, when used according to the label in public and residential areas, do not normally pose an unreasonable health risk to the public. However, there are individuals who have unusual adverse reactions from exposure to certain chemicals. Throughout the country, mosquito-control and public-health agencies recognize the need to provide special notice to people who have identified themselves as chemically sensitive. Some agencies call ahead to the residences of such individuals to provide advance notification of a pending application. Some agencies turn off the insecticide generator when passing such residences. Although, this may appease the chemically sensitive individual, realistically this action does not prevent the property from chemical drift. Adulticides are specifically designed to move with air currents in order to maximize their effectiveness. Momentarily stopping the output while the vehicle passes will NOT ensure that the property is not treated.

**Negative Effects on Non-Target Beneficial insects.** Beneficial insects may be sensitive to public-health pesticides. Honey bee colonies, for example, can be impacted by either ground or aerial application of mosquito adulticides. Product labels may include a statement relating to avoiding exposure of honey bees. Adulticiding after dark protects honey bees because they do not commonly forage in darkness. Many control organizations notify beekeepers of the pending application so that hives can be covered or closed. This is not, however, always successful, as the colonies may be in remote locations and beekeepers may be somewhat reluctant either to register their hives or to notify authorities

of these specific locations. Thus, control agencies often are not aware of the presence of hives even though most municipalities require beekeepers to register.

Another example of the negative effects on beneficial insects is when mosquito control adulticides kill small wasps that parasitize scale insects that in turn damage/kill elm, oak and other hardwood trees. Under normal conditions, scale insects that populate hardwood trees are kept in balance by these small parasitic wasps. Adulticides will kill these wasps resulting in an explosion of scale insect populations which will result in the eventual loss of hardwood trees. Nature has natural controls to suppress other pest insects and the use of adulticides may remove components of the natural cycle which will result in other negative impacts. (Frank A. Hale, UTK Extension Service, Mosquito Spraying and Scale Outbreaks).

Adulticides used by local agencies to control mosquitoes have warning labels and specific preparation and application directions to minimize the risks to human health and the environment. Pesticides should be applied by public health employees who are specifically trained to follow proper safety precautions and who are capable of understanding explicit directions. Pesticide applicators that mix, load, and apply concentrated insecticides are required to use personal protective equipment to avoid personal exposure. The EPA has approved specific products for use on adult mosquitoes only when the preparation and application process is followed exactly. For this reason, mosquito program managers must be diligent in ensuring that applicators are not missing steps in the process not only for their own safety but the safety of the public and the environment. The advantage of adulticiding if applied properly is a fast knockdown of the mosquito populations. Although adulticides have the ability to provide short-term control (3-4 days), it does not address long-term control. If adulticiding is chosen to be the control measure for a particular situation, then the program manager must take into account the negative aspects and be able to justify the decision based on objective hard evidence and not subjective thoughts or feelings

**4. BIOLOGICAL CONTROL:** Biological control is the manipulation of natural agents and their by–products to control pest and vector species. Biological control is advantageous because it is generally host-specific with limited non-target effects. Predacious fish, typically *Gambusia* species (Mosquito fish), are the primary biological control agents used to suppress mosquito populations. All fish species will feed on larval mosquitoes although, the small size of the *Gambusia* species is desirable because they are more likely to be able to maneuver through more shallow areas with emergent vegetation where larger fish will not be able to reach. The shallow areas with emergent vegetation are where mosquito larvae will be present. All fish are indiscriminant feeders and will feed not only on mosquito larvae but tadpoles, zooplankton, aquatic insects and other fish eggs and fry.

## Let's put the actual threat of WNV into perspective.

Nationwide, common preventable problems such as influenza, vaccine-preventable diseases, tobacco-associated illness and accidents cause far more morbidity and mortality than WNV in even the most heavily affected areas. Local health councils must evaluate a local region's public health priorities in light of recent WNV developments. Individual counties and communities must assess the local public health risk and desire for control efforts and balance these against the costs of such a program in relation to other public health needs.

**How does WNV Mortality/Morbidity Compare to Other Causes of Illness and Death in Tennessee?**

| | Year | #Cases | Rate/100,000 Population |
|---|---|---|---|
| Vehicle Accidents (Fatalities and Injury) | 2000 | 1,767,999 | 3107.60 |
| Sexually-Transmitted Diseases | 2001 | 26,912 | 468.80 |
| Smoking-Attributed Deaths | 1999 | 9,624 | 346.00 |
| Influenza-Like Illnesses | 2002-2003 | 18,241 | 317.80 |
| Food-Borne Illnesses | 2001 | 1,774 | 30.90 |
| Influenza & Pneumonia Deaths | Average 1999-2001 | 1,624 | 28.80 |
| Fatal Vehicle Accidents | 2000 | 1,177 | 20.69 |
| Vaccine-Preventable Diseases | 2001 | 534 | 9.30 |
| West Nile Virus (ME and Fever) | 2002 | 56 | 0.98 |
| West Nile Virus Deaths | 2002 | 8 | 0.14 |
| West Nile Virus (ME and Fever) (11/7/03) | 2003 | 26 | 0.45 |
| West Nile Virus Deaths (11/07/03) | 2003 | 1 | 0.02 |

**When Histerical Mothers Call and Threaten to Lock Their Children in the Basement for the Summer-this is the appropriate response:**

**Top 10 Causes of Death in Children Under the Age of 10 (1990) and Rate/100,000 Population.**

| Condition | # Cases | Rate |
|---|---|---|
| Perinatal Conditions | 365 | 49.5 |
| Congenital Malformations | 192 | 26.0 |
| Accidents | 133 | 18.0 |
| Malignant Neoplasms | 27 | 3.7 |
| Heart Disease | 25 | 3.4 |
| Assault (Homicide) | 20 | 2.7 |
| Unspecified Infectious Diseases (NOT WNV) | 14 | 1.9 |
| Meningitis | 11 | 1.5 |
| Influenza/Pheumonia | 11 | 1.5 |
| Septicemia | 10 | 1.4 |
| **WEST NILE VIRUS (2002 and 2003)** | **0** | **0** |

**Top 10 Causes of Death in People Younger than the Age of 85 (1990) and Rate/100,000 Population.**

| Condition | # Cases | Rate |
|---|---|---|
| Heart Disease | 15999 | 283.8 |
| Malignant Neoplasms | 12141 | 215.4 |
| Cerebrovascular Diseases | 4128 | 73.2 |
| Accidents | 2689 | 47.7 |
| Chronic Lower Respiratory Disease | 2854 | 50.6 |
| Influenza/Pheumonia | 1624 | 28.8 |
| Diabetes Mellitus | 1588 | 28.2 |
| Alzheimer's Disease | 1037 | 18.4 |
| Intentional Self-Harm (Suicide) | 718 | 12.7 |
| Nephritis, Nephrotic Syndrome | 620 | 11.0 |
| **WEST NILE VIRUS (2002)** | **8** | **0.14** |
| **WEST NILE VIRUS (2003)** | **1** | **0.02** |

**Stewardship of public health and the environment in which we live should be our top priority.**

**(Public-Health Pesticide Applicator Training Manual, AMCA)**

Insecticides are useful and necessary tools, when their use is required. Appropriate insecticide use at the appropriate time has the ability to improve our quality of life by decreasing the public health threat of disease and nuisance pest. Yet pesticides are not without disadvantages. They are expensive, and, if used inappropriately, they may themselves create human health problems, harm pets, wildlife or other non-target organisms, or have other adverse effects. Pesticides are a double-edged sword that must be used intelligently with an understanding of what they can and cannot do, and with respect for their negative aspects.

Vector and nuisance pests can often be suppressed by non-chemical methods without causing adverse impact. Control organizations have the responsibility to use integrated management strategies when feasible. Strategies that minimize adverse impact on natural enemies of public-health pest or on species diversity and natural abundance of biological control agents would be favored when feasible.

Consider closely the possible side effects of phytotoxicity, fish toxicity, bee toxicity, drift damage, residues, contamination of drinking water or crops, the availability of pesticide baits to organisms other than the target pest, etc. Take care with insecticide applications. When it is necessary to use insecticides, it is often possible to select strategies that minimize the risks of adverse impact. For example, treatment of mosquitoes in the larval stage minimizes the area required for application compared with treatment of adult mosquitoes after they have begun to disperse. Further, the use of an environmentally friendly IGR or microbial insecticide can help to target the pest with the lowest probability of adverse impact. It is incumbent upon the control organization to consider these factors and continually seek methods to reduce the probability of risk from insecticide use.

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