National Pesticide Practice Skills Guidelines for Medical & Nursing Practice

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A Project of the National Strategies for Health Care Providers: Pesticides Initiative

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For more information:
Tel: 202-833-2933 x535
Fax: 202-261-6464
Email: pesticides@neetf.org
Web: www.neetf.org/health/providers/index.shtm

The National Environmental Education & Training Foundation
1707 H Street, NW, Suite 900
Washington, DC 20006-3915

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Reviewers

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John Balbus, MD, MPH ..... George Washington University, School of Medicine
Patricia Bauman ..... The Bauman Foundation
Geoffrey M. Calvert, MD, MPH, FACP ..... National Institute for Occupational Safety & Health
Kerry Hoffman-Richards, PhD ..... Pennsylvania State University, Pesticide Education Program
Ruth Kahn, DNSc ..... Health Resources and Services Administration, Bureau of Health Professions, Division of Medicine
Philip J. Landrigan, MD, MSc ..... Mount Sinai School of Medicine
Ann Linden CNM, MSN, MPH ..... Liaison for American College of Nurse-Midwives
Paul Locke, JD, DrPH ..... Trust for America's Health
Edward Master, RN, MPH ..... U.S. Environmental Protection Agency, Region 5
Robert K. McLellan, MD, MPH ..... Institute and Center for Human Development and Environmental Health Service
Ameesha Mehta-Sampath, MPH ..... U.S. Environmental Protection Agency, Region 2
Melissa Melum RN, BSN ..... University of Maryland, School of Nursing, Environmental Health Education Center
Claudia Miller, MD, MS ..... The University of Texas, Department of Family and Community Medicine; South Texas Environmental Education & Research Program
Lillian Mood, RN, MPH, FAAN ..... Retired Public Health Nurse & Community Liaison
Patrick O'Connor-Marer, PhD ..... University of California, IPM Education and Publications
Donna Orti, MS, MPH ..... Agency for Toxic Substances & Disease Registry
Dorothy Powell, EdD, RN, FAAN ..... Howard University, College of Pharmacy, Nursing & Allied Health Science
Mark Robson, PhD, MPH ..... University of New Jersey, School of Public Health
Elaine Rubin, PhD ..... Center for Interdisciplinary, Community-Based Learning and Association of Academic Health Centers
Barbara Sattler RN, PhD ..... University of Maryland, School of Nursing
Gina Solomon, MD, MPH ..... Natural Resources Defense Council
David Stevens, MD ..... Association of American Medical Colleges
Michael Stimmann, PhD ..... University of California, Davis, Center for Pest Management
Daniel Sudakin, MD, MPH ..... Oregon State University, Department of Environmental & Molecular Toxicology
David Wallinga, MD, MPA ..... Institute for Agriculture and Trade Policy

Although the reviewers listed above have provided constructive comments and suggestions, they were not asked to endorse the content nor did they see the final draft of the document before its release. Responsibility for the final content rests with the authors and The National Environmental Education & Training Foundation.

Authors

Project Coordinators:

Andrea R. Lindell, DNSc
Past President, American Association of Colleges of Nursing
Dean, College of Nursing
Senior Associate Vice President
University of Cincinnati
Cincinnati, Ohio

George M. Bernier, Jr., MD
Professor of Medicine and Emeritus Dean
University of Texas Medical Branch
Galveston, Texas

Education Team:

Candace Burns, PhD, ARNP
Representative, National Organization of Nurse Practitioner Faculties
University of South Florida College of Nursing
Tampa, Florida

James R. Roberts, MD, MPH
Assistant Professor, Department of Pediatrics
Medical University of South Carolina
Charleston, South Carolina

Practice Team:

Bonnie Rogers, Dr.PH, COHN-S, LNCC, FAAN
Past President, American Association of Occupational Health Nurses
University of North Carolina School of Public Health
Chapel Hill, North Carolina

Cathy Simpson, MD, MPH
Wayne State University School of Medicine
Detroit, Michigan

Pesticide Extension Representative:

Amy E. Brown, PhD
President, American Association of Pesticide Safety Educators
Associate Professor, Department of Entomology
University of Maryland
College Park, Maryland

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Foreword

Pesticide poisoning in the United States remains under-recognized and under-treated. The lack of attention to pesticide poisoning persists despite the ubiquity of pesticides in our homes, workplaces, and communities, and despite the considerable potential for pesticide-related illness and injury. Communities expect that their primary care providers will be prepared to deal with pesticide-related health conditions, as well as other environmental illnesses, but often times they are not.

This document is part of a national initiative aimed at changing the current situation. The *National Strategies for Health Care Providers: Pesticides Initiative* has set forth a strategic direction for the nation to improve the recognition, management, and prevention of pesticide-related health conditions. The vision is for all primary health care providers to:

- Possess a basic understanding of the health effects associated with pesticide exposures as well as broader environmental exposures.
- Take action to ameliorate such effects through clinical and prevention activities.

Achieving this vision means incorporating some changes in educational institutions related to the health professions – medical schools, nursing schools, residency, and practicum programs – to equip students better to deal with pesticide-related exposures and health conditions. It also means a concerted effort on the part of health care professionals to advance their awareness and skills in recognizing and managing pesticide-related illnesses.

These guidelines outline the knowledge and skills that health care professionals need to have about pesticides. We recognize the multitude of demands on practitioners to stay abreast of rapid advances in research and technology. Nevertheless, pesticides continue to warrant an increased level of concern – both in order to provide the best health care for patients, and as a first step in addressing the growing problem of environmental toxins. We hope these guidelines help in reaching these goals.

Andrea R. Lindell, DNSc

George M. Bernier, Jr., MD

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

Introduction

These guidelines form one of two documents that outline the competencies and skills that health care professionals should have in the pesticides/environmental health area. This document defines the skills and knowledge base that should be mastered by primary care physicians and nurses in the practice arena. The companion document focuses on the knowledge base that should be mastered by students as part of medical or nursing training. The authors of both documents collaborated to ensure consistency across both reports.

The two documents were developed for everyday, frontline health care professionals, not for specialists and researchers. The Educational Competencies document is aimed at basic and advanced components of educational institutions, rather than specialties such as occupational and environmental medicine. Similarly, these Practice Skills guidelines are aimed at primary care providers, rather than medical toxicologists or specialists in occupational or environmental medicine. Specifically, primary care providers are defined as:

> physicians, nurses, nurse practitioners, physician assistants, midwives, and community health workers specializing in one of the following areas: family medicine, internal medicine, pediatrics, obstetrics/gynecology, emergency medicine, preventive medicine, or public health.

As the "gatekeepers" of our health care system, all primary care providers should possess basic knowledge and skills related to pesticides – and more generally, to other exposures to occupational and environmental toxins.

Background on Pesticides and Health Care Providers

The need for improvements in environmental health training has been expressed by a number of health professional groups, academic institutions, as well as government and community organizations. In 1994, the American Medical Association adopted a resolution urging Congress, government agencies, and private organizations to support improved strategies for the assessment and prevention of pesticide risks. These strategies included systems for reporting pesticide usage and illness, as well as educational programs about pesticide risks and benefits.

In a number of studies published in the 1990s, the Institute of Medicine expressed its concern that health care providers are not prepared to manage this problem, focusing on the issue of environmental health education and the roles of nurses and physicians (IOM 1988, IOM 1991, IOM 1993, Pope et al, 1995). Each report outlined the deficits in current educational curricula for environmental medicine, and recommended improvements. At a minimum, primary care physicians and nurses should be able to identify possible occupationally or environmentally induced conditions and make appropriate referrals (IOM 1988). The 1993 report offered additional recommendations: eliciting a detailed environmental history, recognizing signs and symptoms, understanding the relevant toxicology and exposure factors, identifying the available resources for assistance, and understanding legal and ethical responsibilities.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

The *National Strategies for Health Care Providers: Pesticides Initiative* (http://www.neetf.org/Health/providers/index.shtm) began in 1998 and is a partnership of the U.S. Environmental Protection Agency (EPA) and The National Environmental Education & Training Foundation (NEETF), in collaboration with the U.S. Department of Health and Human Services (DHHS), the U.S. Department of Agriculture (USDA), and the U.S. Department of Labor (DOL) .

From the outset, this national interagency initiative has been conceived of as a long-term effort. Working with an expert panel and multiple workgroups, the initiative sought a broad-scale involvement of stakeholders, including federal agencies, academic institutions, professional organizations, foundations, farmworker and farm groups, industry and trade associations. As part of this initiative, EPA issued a substantially revised edition of *Recognition and Management of Pesticide Poisonings* (Reigart and Roberts, 1999), a landmark handbook used by health care professionals around the world. In 2002, the *Implementation Plan: National Strategies for Health Care Providers: Pesticides Initiative* was published (NEETF, 2002) which outlines a set of strategies to move the initiative forward in education, practice, and resource development.

Role of Health Care Providers

Primary care providers are on the frontlines of health care. Patients and communities often look to their primary care providers as important sources of information and guidance on suspected pesticide-related health conditions. Primary care providers can play a key role in identifying and ameliorating potential pesticide poisonings and exposure – but only if they are prepared for this role and know where to turn for assistance. Providers must be able to problem solve with patients who think an exposure has occurred. With the potential effects of pesticide exposure on health so widespread and consequential, an understanding of the pathophysiology and management of pesticide exposure and toxicity is important in all areas of health care practice (general and advanced/specialty), including assessment, diagnosis, planning intervention/treatment, and evaluation (IOM 1993, Pope et al, 1995).

Prevention, health maintenance, and illness and injury management are included in the management of pesticide exposure. Essential skills include a basic understanding of the health hazards of pesticides, prevention and abatement methods, recognition, diagnosis, and treatment of pesticide exposure, and utilization of resources for referral and assistance at both a patient and community-based level. In addition to direct patient interventions, health care providers may assume the role of educator, advocate, and policy planner on behalf of an individual patient or population of patients.

When pesticide toxicity is discussed, most people usually think of an acute pesticide poisoning incident in an agricultural setting. However, pesticide exposure regularly occurs in settings outside agriculture as well, including urban environments, homes, and schools. Pesticides are also of concern because of potential chronic health effects from long-term exposures. This is particularly important for children, given their developmental risks for pesticide exposure and due to pesticide residues on food.

Health care providers must be aware of the potential effects of pesticide exposure on high-risk groups such as infants, children, the elderly, and those with compromised immune systems. The issue of children's susceptibility prompted Congress to enact the Food Quality Protection Act of

1996, the highlights of which are discussed in Competency I-3 of this document. Epidemiological studies tend to focus on worker exposure. Since the majority of the pesticide applicator work force is overwhelmingly male, studies of women exposed to pesticides at work are few. In the absence of good data, pregnant women should take extra care to avoid exposure to pesticides.

A comprehensive approach to nursing and medical practice requires awareness, recognition, and treatment of critical factors that affect individual and community health, even if these factors are not obvious at first to patients or providers. This initiative recognizes the unique role and functions served by registered nurses and advanced practice nurses. In urban, suburban, and rural settings, nurses are often the initial, and sometimes only, points of contact for people seeking health care. In the context of a busy medical practice, physicians often rely on nurses to provide more in-depth patient education on many preventive issues, and pesticide-related exposures may be included among these. Community or home health nurses also may visit patients in their homes, workplaces, and local communities, thus gaining firsthand knowledge of potential pesticide exposures in these settings (Pope et al, 1995). Where possible, the physician should maintain community contacts as well, as is the case with those with particular expertise in environmental health and occupational medicine. The opportunity for close interactions when health care providers are "onsite" provides a better chance of detecting previously unrecognized health problems related to pesticide exposure.

Finally, health care providers have a role to play in minimizing the unnecessary use of pesticides. Integrated Pest Management (IPM) is a sustainable approach aimed at providing effective control of pest populations while minimizing economic, health, and environmental risks. Rather than relying solely on pesticide applications, IPM employs other tactics as well, including biological control controls (parasites and predators); cultural controls such as mulching to prevent weeds, varying planting dates to avoid susceptible windows for pest infestation, etc; and physical controls such as installation of screens, improved sanitation practices, etc. Based on the identification of pests, monitoring of pest populations, assessment of damage levels, and knowledge of available pest management strategies, an IPM specialist can provide intelligent advice. Many successful IPM programs have reduced energy inputs and pesticide use. Health care providers should encourage patients and communities to contact their local Cooperative Extension offices (see the county listings of the local telephone book) for advice on IPM programs and strategies suitable for their homes, yards, schools, and communities.

Integrating Pesticide Issues into Practice Areas

There are numerous opportunities for incorporating pesticide issues into the ongoing practice of health care as well as in the context of professional development. Examples include the full range of continuing education programs; demonstration programs that can serve as models for other practices; policy statements issued by national professional associations; building pesticide/environmental health education into Internet-based continuing education offerings; certification of training in pesticide issues; and the development of a variety of resources and training packages to assist health care providers. As is usually the case, multiple methods of integrating the topic are likely to be most effective.

These guidelines begin with a brief "primer" on pesticides covering background material on pesticide regulation, uses, exposures, and absorption. This is followed by a literature review, and more

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

detailed ideas on how pesticide issues can be incorporated into practice areas, as well as key principles of adult education. The remainder of the document outlines six recommended practice skill areas, including information content and a sampling of relevant resources.

Although this document is not intended as a handbook for health care practice, it does contain some useful tables for quick reference. Health care professionals are urged to consult the *Recognition and Management of Pesticide Poisonings* (Reigart and Roberts, 1999) for detailed information on handling pesticide cases. Readers are also encouraged to make use of the extensive resources available on the Internet. Useful starting points include: National Pesticide Information Center (www.npic.orst.edu), and NEETF's Pesticide Resources Library (www.neetf.org/Health/Resources/healthcare.htm).

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A Pesticide Primer

A pesticide is defined as any substance that is used to kill or otherwise control a pest. The term "pesticide" includes insecticides, herbicides, fumigants, fungicides, repellents, rodenticides, and disinfectants. About 940 million pounds of pesticidal active ingredients are applied yearly to agricultural land to control insects, weeds, fungi, nematodes, bacteria, and other crop pests (Aspelin and Grube, 1999). This figure accounts for about three-quarters of the total used, with the remainder split about evenly between applications by homeowners and professional pest control applicators (Aspelin and Grube, 1999). However, it should be noted that on a per-acre basis, homeowners use many times more pesticide on their lawns and gardens than the amounts applied on agricultural land (Robinson et al, 1994).

Pesticides in use in the U.S. today differ in significant ways from the pesticides relied on from the 1940's through the 1970's. DDT and several other organochlorine insecticides have long since been banned from use in this country. Although these older products tended to have low acute toxicity to humans, they had very long half-lives. Their persistence in the environment, coupled with their tendency to be stored in fat, allowed them to accumulate in living organisms and to bioconcentrate in the food chain.

By contrast, the newer pesticides tend to have shorter half-lives and to be water-soluble, so that they are excreted (primarily in urine) and are less persistent in the environment. However, the acute toxicity of some of the newer products (notably organophosphate and carbamate insecticides) is much higher than the older products, making them more hazardous for users to handle. In addition, their increased water solubility raises the likelihood of contamination of ground water as a result of improper application, poor well construction, improper disposal, or leaching. Whereas earlier pesticides were aimed at controlling a broad spectrum of pests, many pesticides today are far more specific in their action. Also, today's pesticides are effective at much smaller concentrations than in the past. Together, the latter two factors mean that a larger variety of different products are in use, but in a far smaller volume (ounces per acre, rather than pounds per acre) than in the past. Nevertheless, overall pesticide use (lbs/yr) has steadily increased over the years.

By volume, herbicides account for the majority of applications to agricultural crops. Other uses of pesticides include applications to:

- forests to control insects and understory vegetation;
- rights-of-way along railroads and under electric wires to control vegetation;
- boat hulls to control fouling organisms;
- houses, schools, and commercial and office buildings to control insects, rodents, and fungi;
- landscapes, parks, and recreational areas to control weeds, insects, and disease pests;
- aquatic sites to control mosquitoes and weeds;
- wood products to control wood-destroying organisms;
- food preparation areas to control insects and rodents;
- human skin to kill or repel insects;
- household pets to control fleas and ticks; and
- livestock to control insects and other pests.

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When used properly, pesticides can benefit humans and the environment. Pesticides control important crop pests, ensuring a plentiful and diverse food supply. They prevent disease in humans and animals, and control pests that infest homes, schools, hospitals, food warehouses, and other buildings.

The remainder of this section provides an overview of the regulation of pesticides, effects of pesticidal formulations on potential absorption into the body, and patterns of exposure to pesticides.

Regulatory Context

In the United States, the Environmental Protection Agency (EPA) is responsible for regulation of pesticides. Pesticides may only be sold in the U.S. if EPA has reviewed and approved the manufacturer's application for registration, and determined that use of the product will not present an unreasonable risk to humans or the environment. A pesticide that passes EPA's scrutiny will be registered for use on specific crops or sites, and must be sold with specific label directions for how the product is to be used.

Nearly 900 active ingredients and more than 20,000 pesticide products are registered for use in the U.S. (Aspelin and Grube, 1999). Each pesticide product consists of one or more **active ingredients** (the substance that kills or controls the pest) and may have one or more inert ingredients (substances for which no pest control claim is made). **Inert ingredients** are added for a number of reasons, such as to make the product safer or easier to apply, or to increase the efficacy of the active ingredient by making it last longer in the range of the target pest. Inert ingredients may also cause adverse effects in people and/or the environment. As of the writing of this document, inert ingredients are not required to be identified on the pesticide label, although their percentage must be indicated. EPA is considering changes that would require some or all inert ingredients to be identified on the label.

A single active ingredient may be registered for different uses – such as several different crops, a yard, and a food warehouse – and the concentration, application method, and application rate may differ for each use. Also, products with the same active ingredient may include different inert ingredients. For most applications, such as crops, pets, and livestock, pesticide usage patterns are seasonal. For other uses, such as structural pest control and greenhouse situations, pesticide applications may continue throughout the year. Pesticides may be applied as sprays, dusts, granules, baits, fumigants, injection systems, roll-on applications, shampoos or animal dips, and other methods.

Each active ingredient intended for use on food must have a **food tolerance** established. The tolerance is the legal amount of residue that may remain in or on the food at harvest. EPA sets a specific tolerance for each pesticide/crop, pesticide/meat, or pesticide/meat byproduct combination. Pesticides used on food or feed crops often have a pre-harvest interval (PHI) established by EPA that appears on the product label. The PHI is the amount of time that must pass before a treated crop can be harvested. The PHI is important in allowing time for the pesticide to degrade to a level at or below the legal tolerance.

In setting a tolerance, EPA considers the relative proportion of each food in the diet, as well as the acute and chronic toxicity of the active ingredient. Differences in the foods most relied on for infants and children's diets are also considered. Under the Food Quality Protection Act of 1996,

EPA was charged with reviewing all tolerances for existing pesticides within ten years to determine that they pose a "reasonable certainty of no harm" from aggregate and cumulative exposures. Aggregate exposure refers to exposures from all sources, including residues in food and drinking water, occupational exposures, and incidental exposures. Cumulative exposure refers to exposure to different pesticides that share a common mechanism of action.

Pesticides that may cause unreasonable adverse effects on humans and/or the environment even when used according to label directions are classified by EPA as restricted use pesticides (RUP). These products may be purchased and used only by certified applicators, or by someone under the supervision of a certified applicator. In order to become certified, applicators must receive instruction in the proper use of RUPs and, in most states, pass a written examination. By federal law, all pesticides not classified as RUP are available for sale to, and use by, anyone without a requirement for special training. However, many states have stricter pesticide laws requiring training and/or certification for anyone who applies pesticides to someone else's property, regardless of whether the product used is classified as RUP.

Pesticide Quick Facts

- There are approximately 4 million members of the agricultural workforce in the U.S. and a million or more pesticide applicators who are at potential risk for pesticide exposure because of mixing or applying pesticides or working in fields where pesticides have been applied. (U.S. EPA, 1992)
- Based on states with required reporting of pesticide-related health concerns, EPA estimates that approximately 250-500 physician-diagnosed cases occur per 100,000 agricultural workers (including pesticide handlers) (Blondell, 1997).
- Migrant and seasonal farmworkers are especially at high risk since they often work and live in poor occupational environments where pesticide exposures can be significant.
- A 1990 EPA survey estimated that 84% of American households used pesticides, most commonly insecticides (Whitmore et al, 1992). Homeowners annually use 5-10 pounds of pesticide per acre on their lawns and gardens, many times the amount applied by farmers to corn and soybean fields. (Robinson et al, 1994).
- Disinfectants are a widely-used source of non-agricultural pesticide exposure (e.g., pine oil cleaners, bathroom cleaning products, and cleaning materials for swimming pools). Work-related exposures for structural pest control operators and workers in nurseries, greenhouses, and landscaping are also of concern in the non-agricultural sector. The medical profession uses disinfectants to sanitize and sterilize surfaces and instruments.
- Organophosphate and pyrethroid insecticides are the categories of pesticides most often implicated in acute pesticide-related illnesses reported to poison control centers.
- Chlorination for purposes of purifying water is one of the largest (by tonnage) uses of pesticides.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

About three-fourths of U.S. households use pesticides (Aspelin and Grube, 1999). Few homeowners who use pesticides themselves have received any training. Because pesticide products can be purchased at grocery stores, hardware stores, and pharmacies, consumers may assume that the products they themselves apply do not pose potential hazards to health or the environment. In fact, most products marketed for the homeowner contain the same active and inert ingredients as those for commercial markets, although usually at lower concentrations.

Pesticides are designed to be toxic to the pests they control, but they may also pose risks to humans and wildlife. Therefore, it is extremely important that pesticides be used only in strict accordance with the label. A pesticide should never be used on a crop, plant, or site for which it is not labeled, and should never be applied more frequently or at a higher rate than the label allows. Potential risks can be minimized by choosing alternative measures when feasible and by using pesticides sparingly. When applying pesticides, care should be given to wearing the proper protective gear (as indicated on the label), and applying, storing, and disposing of pesticides properly. Consideration should also be given to the presence of children in the area. Children are more apt to have extended contact with ground level surfaces and may have extended contact with pets. Spot treatments, directed or crack and crevice sprays, baits, gels, and pastes pose less potential for exposure than broadcast treatments.

Exposure and Absorption

There are three main routes of exposure: oral, inhalation, and dermal. (Eye exposure is considered a special type of dermal exposure.) Most pesticide active ingredients can be absorbed to some extent by all three routes, but the formulation of a product has a large effect on potential absorption:

- **Emulsifiable concentrates** (liquid active ingredient with one or more petroleum-based solvents and an agent that allows the product to form an emulsion when mixed with water) and **ultra-low-volume concentrates** (products that may approach 100% active ingredient and are designed to be used as is or diluted with only very small quantities of water) are easily absorbed through the skin.

- **Wettable powders** (dry, finely ground formulations designed to be mixed with water) are less easily absorbed than emulsifiable concentrates and other liquid pesticide formulations, but the powder may be inhaled during the mixing/loading process.

- **Fumigants** (pesticides that form poisonous gases when applied) are highly toxic to humans and all other living organisms. Some active ingredients are liquids when packaged under high pressure but change to gases when released. Others are volatile liquids when enclosed in an ordinary container and so are not formulated under pressure. Still others are solids that release gases when applied under conditions of high humidity or in the presence of water vapor. Fumigants can injure workers severely through inhalation and dermal exposure even in a short period of exposure. They require the use of specialized protective equipment, including respirators.

- **Aerosols** (typically, low percentage of active ingredient sprayed out as a fine mist or fog) are difficult to contain on site and are easily inhaled.

- **Dusts** (typically, a low percentage of active ingredient plus a very fine, dry, inert carrier

made from talc, chalk, clay, nut hulls, or volcanic ash) are applied as dry material. Dusts are less easily absorbed through the skin but are easily inhaled. Some dusts, such as sulfur, contain high levels of active ingredient. Sulfur is one of the most heavily used pesticides in California and has been responsible for the highest number of pesticide-related illnesses/injuries there.

- **Granules** (low percentage of active ingredient with larger, heavier absorptive materials such as clay, corn cobs, or walnut shells forming the carrier) are also applied dry but pose less risk of inhalation.

- **Baits** (low percentage of active ingredient mixed with food or another pest-attractive substance) may pose an ingestion hazard if they are placed where children or pets can access them.

Patterns of Exposure

Three types of exposure patterns are considered here: occupational, incidental, and intentional exposures.

Occupational Exposures

People who work in manufacturing or distribution plants for pesticide products have the most *potential* exposure to pesticides, but they often have relatively low *actual* exposure as a result of the installation of engineering controls at the facilities and use of **personal protective equipment (PPE)**. Wettable powders and most liquid pesticide products, except those specifically designed for use by homeowners, require dilution with water, oil, or other solvent prior to application. Those who mix and load the concentrates into the application equipment also have a high potential for exposure, especially if they do not wear the PPE designated on the product label. Farm workers, migrant laborers, and others who must reenter treated areas to perform tasks such as cultivation, harvest, irrigation, and equipment maintenance, may be exposed to pesticide residues remaining on the plants, but their jobs may require them to spend more time in treated areas than the applicator.

Since the majority of the pesticide applicator work force is overwhelmingly male, there are few studies of women exposed to pesticides at work. Women who work with pesticides may want to consider switching to other tasks, if possible, at least during the first trimester of pregnancy, or should maximize their use of personal protective clothing.

EPA's Worker Protection Standard is the federal regulation that applies to agricultural pesticide handlers and field workers. It includes requirements for: posted warnings about pesticide applications, use of personal protective equipment (PPE), restrictions on re-entry into treated areas, decontamination, emergency medical assistance, and pesticide safety training.

To keep exposures at safe levels, the pesticide product label specifies whether PPE must be worn; the length of time that workers must wait after treatment before reentering a treated area without PPE (called the **restricted entry interval** or **REI**); and whether training is required for workers and pesticide handlers on farms, forests, greenhouses, and nurseries. As of the writing of this document, the REI applies only to workers, not to the general public. EPA is currently

considering instituting separate REIs for others, including, for example, consumers who enter treated "pick-your-own" operations. The rationale is that workers may be in the field eight hours per day for many days, while a consumer would only be in the field for a short period of time. Thus, the exposure potential for workers is much greater than for consumers, and the REI established for each type of reentry might differ.

The type of equipment used in applying pesticides provides different opportunities for exposure. The selection of equipment varies with the crop or site, the formulation of the product, the pest being targeted, the pesticide chosen, and the economic situation of the applicator or business. Airplanes and helicopters, tractor-mounted sprayers, backpack sprayers, canister sprayers (commonly referred to as B&G type), granular spreaders, and other equipment may be used. Some application equipment, such as closed cab systems where the operator is separated from the surrounding environment, provides very good protection from exposure. Sometimes pesticides can be loaded through closed systems, where there is very little opportunity for exposure of the mixer/loader. Many structural applications of liquid pesticides call for crack and crevice treatment, i.e., a stream of pesticide is directed into the angles formed where floors and walls meet or other such corners along which pests run, rather than a broadcast or space spray. Homeowners usually have the least specialized application equipment, but they are usually applying dilute materials.

Many types of personal protective equipment are available, and label directions specify what equipment must be worn when performing specific tasks, such as mixing and loading, applying, or reentering treated areas. In general, the hands and forearms receive the most exposure. Depending on the application equipment, splashback may occur to the lower legs, drift may fall on the head and ears, or a vortex effect may be generated, resulting in contamination of the back of the neck. A full protective suit, gloves, respirator, hood, and boots, while providing excellent pesticide protection, constitutes a very hot outfit and may present a heat stress hazard. Applicators may also be overexposed if equipment is not properly maintained, e.g., when respirator filters are not changed often enough.

Incidental Exposures

Outside of occupational exposures, people may be exposed to pesticides through residues in foods and water; in and around their apartment buildings, homes, and yards; in their office buildings, schools, and public buildings; and at recreational areas. National attention is focusing interest on **integrated pest management** (IPM) strategies rather than relying solely on conventional pesticide treatments in and around schools and public buildings. Long utilized in many agricultural systems, IPM combines physical, cultural, biological, and other means of pest control as well as the use of pesticides to minimize the potential adverse effects on human health and the environment. IPM considers aspects such as pest detection, quantification of threshold levels for treatment, placement of pesticide, and timing of applications in the interests of maximizing crop yield, aesthetic benefits, and public health. Pesticides may be needed, for instance, to control cockroaches and rodents in school cafeterias, but they may be applied as baits contained in bait stations, with little opportunity for exposure of children and staff. Herbicides are frequently needed to control weeds on athletic fields to prevent potential injuries associated with uneven playing surfaces, but they may be applied as spot treatments rather than broadcast applications.

Many homeowners have herbicides and fungicides applied to their lawns throughout the growing season either by themselves or by commercial firms. Consumers also use insecticides, herbicides, and fungicides on their own fruit and vegetable gardens and inside their homes and apartments. Because members of the general public do not have special training or knowledge about the proper use of pesticides, they may be more likely to misuse pesticides than trained commercial applicators. They may use a pesticide at a higher rate or more often than the label allows, or not use PPE to minimize exposure.

Another problem is use of a pesticide on a site for which the product is not registered, e.g., application of pesticides labeled for use on ornamentals to vegetable and fruit gardens, or use of a pesticide labeled for outdoor application only to areas inside homes or apartments. Some products are not registered for additional sites only because there has been no particular need for them (for instance, if more effective products already exist for such use), but in other cases, the product is not registered for a particular site because it would present a hazard. A common source of accidental exposure in the home is improper storage of household pesticides, especially in areas accessible to children. Children and others have also been injured when empty pesticide containers have been re-used for other purposes, as residues remain in the containers.

Infants, children, the elderly, and those with compromised immune systems are at special risk if overexposed to pesticides. Children incur more risk than adults due to the immature nature of their immune system, larger surface area to body weight ration, higher metabolic rate, different diet patterns and activities, different exposure profiles, and hormonal changes at puberty.

Intentional Exposures

Suicide attempts, primarily through ingestion, have accounted for deaths and serious injuries. A total of 808 cases of suicide attempts involving pesticides were reported to Poison Control Centers in 1995 (Litovitz et al., 1996). Pesticides used in suicide attempts are often those commonly found in homes or on farms.

Pesticides are thought to be a possible choice for terrorists. Even products not considered to be highly acutely toxic could disrupt the infrastructure and/or cause panic if introduced into water sources, sprayed over populated areas, or otherwise misused.

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Literature Review

The literature review conducted for this effort yielded a small selection of articles that point to the relatively limited knowledge of pesticides and pesticide-related illnesses on the part of primary health care practitioners. The studies conducted suffer somewhat from limited sampling strategies and response rates.

Ferguson et al (1991) examined over 1,026 suspected pesticide poisoning reports received at the regional Poison Control Centre at the Hospital for Sick Children in Toronto. The purpose of this study was to evaluate predictors for pesticide poisoning which included season, age, professional vs. lay caller, gender, and location (metropolitan vs. non-metropolitan). Variables mentioned were type of pesticide (insecticide or rodenticide), amount of exposure, symptoms, and treatment (measured as referral). Age was the strongest predictor for all the outcome variables. There was a ten-fold risk of pesticide poisoning symptoms for victims over five years of age as well as six times the likelihood of being referred for the same age group. The season predicted type of pesticide used. The major limitation of this study was that the investigators had no way of knowing if callers were truly pesticide-poisoned. Also, data reported are only for those with suspected poisoning. The implication for health care professionals is to be knowledgeable about pesticide exposure and outcome, and the need to provide adequate treatment.

Henry (1997) provides a good overview of pesticide symptoms seen in the primary care office. He notes that pesticide use is ubiquitous in the United States. The World Health Organization (WHO) estimates that there are 3 million severe, acute cases of pesticide poisoning annually worldwide. An estimated 2 million of these cases are the result of suicide attempts. WHO estimates that another 500 million are exposed less intensively (and thus generally know less about the hazards of pesticides and preventive measures than those who are more intensively exposed). In the United States, EPA estimates that up to 300,000 acute poisonings occur annually in agriculture workers. The wide range of the estimate is influenced by inaccurate diagnosis and underreporting. Sources of exposure are most frequently related to one's occupation or environment, with a third group of persons exposed by being family members of those occupationally exposed. Occupations at risk for pesticide exposure include, but are not limited to, the following: ranch and farm workers (including migrant workers), gardeners (home and professional), groundskeepers, florists, structural pest control workers, hunting and fishing guides, health care workers who deal with decontamination, and people employed in pesticide production, mixing, and application. Environmental exposures include treated foods and plants, ground- and/or well-water contamination, and breast milk and placental transfer.

Henry notes that at particular risk are household members who launder clothing worn during production, mixing, or application of pesticides. Second-hand exposure is related to storage of contaminated clothing and laundry practices of family members, as documented in a recent California study. Even though inhalation and ingestion of pesticides occurs, skin contact with topical absorption is the main source of exposure to pesticides. Skin may be sprayed during

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

application of chemicals to crops, or there may be absorption through permeable clothing. Clothing worn during pesticide application must be washed after each application. The primary care provider must be alert to both acute and chronic signs of pesticide poisoning. Sources of exposure in the home, community, and worksite must be identified.

Lessenger (1999) states that the family physician in the office environment is often the first professional to see a person who has been exposed to pesticides; and the author discusses the importance of being prepared to make a precise diagnosis and provide appropriate treatment. The author provides five representative case studies for review and analysis, citing the need to conduct a work-up in a thorough methodological manner with emphasis placed on assessment.

Sanborn (1998) reports that patients with illnesses that have environmental factors often turn first to family physicians. Family physicians thus have an excellent opportunity to provide information to patients about environmental health concerns. The environmentally competent clinician has been defined as one who can identify patients with environment-related illnesses and can provide clinical care and advice, including appropriate referral and follow-up assessment. The objectives of this study were to describe environmental health problems encountered in some Ontario family practices and to describe differences among physicians from urban (small and large) and rural practices. A self completed questionnaire was mailed to 521 eligible community family physicians with a 41% (n=214) response rate. Environmental health problems encountered in family practice were determined using questions about:

- Concerns of physicians (health effects seen in practice)
- Reported patient questions
- Identified high-risk groups
- Environmental exposure-related problems
- Self-rated knowledge
- Priorities for public health control of environmental pollutants and
- Current and preferred sources of information

Family physicians surveyed in this study had a high level of concern about a range of health effects of environmental exposures with respiratory and carcinogenic effects of greatest concern. Pregnant women, agricultural workers, and children were considered important at-risk groups. Self-ratings of knowledge were generally very low. Rural physicians were concerned about agricultural pesticide exposure and their patients were concerned about moldy hay. Urban physicians had concerns about lead and reported patient concerns about chemical exposure from consuming Great Lakes fish. All groups use similar sources of current environmental health information. This study suffers from lack of demographic information about respondents as well as self-reported data without validation.

Watterson (1992) discusses training needs and available information for general practitioners regarding acute pesticide poisoning. A postal questionnaire was sent to 68 general practitioners in

a District Health Authority of the United kingdom with an 82% (n=56) return rate. Watterson found that general practitioners do not have sufficient training and information needed to evaluate possible acute pesticide poisoning.

In the nursing area, Baker (1992) discusses the role of the community health nurse in assessing and preventing pesticide exposure in farmers: clinical health nurses practicing in rural emergency care settings are most likely to assess for signs and symptoms of moderately severe poisonings. Clinical health nurses practicing in clinics, community health practice, physician offices, and hospitals are most likely to encounter mild and/or chronic exposure signs and symptoms. Thus, the clinical health nurse must be able to differentiate between acute and chronic pesticide poisoning.

The clinical health nurse practices at all levels of prevention. The rural clinical health nurse might initiate prevention strategies by working with the county agricultural extension office, agriculturally based universities, pesticide dealers, and local concerned physicians and hospitals. Farm Bureau organizations, agriculture classes in the high schools, and 4-H clubs are target groups that could benefit from this information. In urban settings, clinical health nurses may work with garden clubs and plant nursery customers. Primary prevention through education of farmers regarding safety and health practices when using pesticides is the most effective means of dealing with pesticide health threats. Informing farmers of the dangers of ineffective protection against pesticide exposure is the first step. There are many resources available for the clinical health nurse to use in planning and implementing the teaching intervention. Pamphlets, slide presentations with scripts, and other materials, can be secured easily. Pesticide safety should be included in programs that address prevention of other farm accidents.

The clinical health nurse will encourage farmers to participate in secondary prevention strategies including baseline screening tests to detect certain pesticide-related illnesses (organophosphates, carbamates) and periodic screenings for comparison. At the tertiary prevention level, the clinical health nurse will assist the farmer with rehabilitation/disability management issues related to pesticide exposure.

Schnitzer et al (1999) describes the Texas Department of Health pesticide poisoning surveillance system. The authors compared cases seen in a 2-year period (1989-90) in 16 hospitals and migrant clinics to cases that had been reported to the surveillance system. They found underreporting by surveillance system in this time period (2 out of 10 cases). After instituting some changes (increased number of sentinel providers, periodic reviews of hospital records, interagency collaboration) to increase reporting, reporting was greatly improved. The investigators also found that this was mostly due to the involvement of other reporting agencies (Texas Dept. of Ag; Texas Workers Comp, Texas Poison Center Network) rather than individual provider reporting.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

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Incorporating Pesticides into Practice Skills

The task of incorporating pesticide information into practice skills for primary care providers will require multiple collaborations over a period of years. Examples of the types of recommended efforts to be undertaken under the *National Strategies for Health Care Providers: Pesticides Initiative* include the following:

- Collaborations with established professional societies in planning and co-sponsoring continuing education activities.
  - Mini-symposia
  - Dedicated continuing education modules and monographs for publication
- Collaborations with regulatory/non-regulatory agencies in planning and co-sponsoring traditional and distance education continuing education activities. For example:
  - ATSDR – Teleconference
  - NORA (National Occupational Research Agenda)
  - EPA
  - National Institute of Environmental Health Sciences (NIEHS)
- Working with universities, colleges, hospitals, health care agencies, non-profit organizations, and Area Health Education Centers to plan, develop, and co-sponsor targeted continuing education.

Points of Contact for Training/Refreshing Practitioners

Following are possible venues and points of contact for providing training or refresher courses, experts for lectures or consultations, as well as a flow of information to practitioners on pesticide-related and environmental health issues.

- Agriculture Health and Safety Centers
- Area Health Education Centers (AHEC)
- Case studies
- Certification and recertification exams
- Continuing education (CE) modules
- Conferences
- Continuing education monographs

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

- Cooperative Extension Service Pesticide Safety Education Coordinators
- Distance Learning (Internet)
- Hotlines
- Libraries (universities, Internet, professional associations)
- Inservice education
- Journals
- Medscape, other Internet websites
- Newsletters
- NIOSH Environmental Resource Centers
- Pediatric Environmental Health Specialty Units
- Professional association meetings/conferences (national, state, local)
- Regulatory agency websites and links
- Video demonstrations

Adult Education Principles

In designing and presenting training sessions or refresher courses on pesticides in clinical practice, it is useful to bear in mind the following ideas and principles culled from adult education research.

1. Several factors influence the adult learner:

   - Self-perception of knowledge
   - Preconceived attitudes
   - Experience
   - Level of confidence

2. Health care providers may have already acquired knowledge, formed opinions, and adopted attitudes toward the topic of pesticides and about environmental health in practice.

3. A number of aspects of environmental health may affect the willingness of practitioners to learn about pesticides, and incorporate issues about pesticide exposure into routine clinical practice:

   - Environmental health problems of any kind can be very complex and time-consuming.
   - Reimbursement for services may not be available.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

- The possibility of interacting with the legal system may act as a deterrent to becoming involved in environmental health problems.

- Practitioners may have other sociopolitical and cultural perceptions that may lead to resistance to learning in environmental health, for example: "It's not a problem in my patient population," "I don't agree with environmental activists," "My patients have other more pressing concerns," or "I can't learn all I need to about environmental toxicology."

4. Learners should be encouraged to openly express their perceptions about environmental health issues and the practitioner's role.

5. Individuals must be motivated to learn, so it is important to demonstrate the immediate practical value of addressing pesticide exposure in clinical practice.

6. Assumptions about the significance of pesticides should be challenged (e.g., "Pesticide exposure is not relevant for my patients.").

7. Instructors can affect the learner's self-concept as practitioners by finding out what the learner already knows. The instructor can explore whether or not the learner feels his or her responsibility extends only to treatment or to investigation and prevention of pesticide exposures as well.

8. A short survey can be used to disclose knowledge and attitudes about pesticides and environmental health in general. This information can be used to discuss barriers and issues.

9. There are several key ways in which adults learn:

- By solving problems
- By seeing, listening, and doing
- By remembering the first and last information presented
- Through association and repetition

10. Varying the teaching methods used helps in maintaining the adult learner's interest:

a. Case studies

- Should be short
- Should be as real as possible
- Can be oral or written
- Develop a few specific questions for discussion

b. Group discussions

- May be used to explore issues about investigation and advocacy
- Present a case. *Example: In the past 4 months you and your colleagues have seen 4 children (ages 9 and 10) complaining of cough, shortness of breath and chest tight-*

ness and eye, nose and throat irritation. From an environmental history, you learn that all children attend the same school. The mother of one of the children is concerned that her child is being exposed to something at school.

- Develop discussion questions. Examples:
  - *What is the role and responsibility of the health care practitioner to pursue the mother's suspicions?*
  - *What actions should be taken?*
  - *What actions are required to be taken?*
  - *How could risks be communicated to parents or others who are concerned?*
  - *What should be documented in charts?*
  - *What plan of action is most appropriate for the health care provider?*

c. Instructor/student demonstrations

- Skill building
- Should demonstrate incorrect as well as correct techniques

d. Structured practice/role play

- Opportunity to practice communication skills with help of partner

e. Lectures

- Aim is to establish a baseline of knowledge
- Communication is generally one-way, so other methods should be used to facilitate the learner's problem-solving skills
- Enhance effectiveness of lecture by:
  - Including personal examples, stories, perspectives
  - Limiting the lecture to 45-60 minutes
  - Outlining learning objectives at the beginning and summarizing what was learned at the end
  - Avoiding reading from prepared notes
- Use audiovisual aids
- Distribute handouts summarizing key points
- Hold a large group discussion after lecture

11. Give credit for participation

- Incentives
- Recognition

12. Establish some method of evaluation. Evaluation approaches may include:

- Pre- and post-tests for knowledge evaluation
- Checklists for practice observation to document skills application, such as patient assessment, through direct or indirect (video) observation
- Chart audits for knowledge and skill demonstration
- Evaluation of specific learning objectives
- Community based organizations/groups in evaluation

Pesticide Practice Skills Guidelines for Medical & Nursing Practice: Content and Resources for Practice Settings

The six Practice Skills included in these guidelines are based on the work carried out by NEETF and an interagency committee in 1999 and 2000 under the *National Strategies for Health Care Providers: Pesticides Initiative.* The skills were identified by the Practice Workgroup in 1999 (U.S. EPA, 1998) and were included in the draft and final Implementation Plans (NEETF 2000, 2002). Practice settings in which these skills are expected to be used include, for purposes of this initiative, community health centers and clinics; poison control centers; managed care clinics; hospitals and emergency departments; private practices; urgent care centers; poison control centers; and work and/or school-based clinics.

The six practice skills are shown on the next two pages, along with more specific elements of the skill areas. The first three skill areas – taking an environmental history, awareness of community and individual pesticide risk factors, and knowledge of key health principles – provide the background data, knowledge, and insight that go into making a differential diagnosis and managing a pesticide exposure, described in Practice Skill IV. The remaining two practice skills cover longer-term and wider concerns for managing pesticide exposures, through reporting cases of exposure to the proper authorities, supporting surveillance efforts, and providing guidance and education to patients.

In the remaining sections of this document, each practice skill is discussed in more detail, along with relevant references. A more complete resource library with links to sources of information is available online at www.neetf.org/Health/Resources/healthcare.htm.

References

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Six Practice Skills

Practice Skill I: Taking an Environmental History

I-1. Understand the purposes and general principles for taking an environmental history.

I-2. Incorporate general environmental screening questions into routine patient histories.

I-3. Be able to take a complete environmental exposure/health history for adults and children, covering occupational and non-occupational exposure factors.

Practice Skill II: Awareness of Community and Individual Pesticide Risk Factors

II-1. Possess basic awareness of environmental aspects of communities in which patients live.

II-2. Recognize high risk occupations for pesticide exposure.

II-3. Develop community resource list.

Practice Skill III: Knowledge of Key Health Principles

III-1. Demonstrate key principles of environmental/occupational health, epidemiology, and population-based health.

III-2. Understand the dose-response relationship.

III-3. Understand measures of morbidity/mortality and study designs.

Practice Skill IV: Clinical Management of Pesticide Exposure

IV-1. Recognize the signs and symptoms of pesticide exposures (both acute and chronic).

IV-2. Diagnose pesticide-related illness using appropriate testing procedures and treat pesticide over-exposures.

IV-3. Treat and manage health conditions associated with pesticide exposure or refer patients to appropriate specialists and resources, and follow up appropriately.

Practice Skill V: Reporting Pesticide Exposure and Supporting Surveillance Efforts

V-1. Understand the importance of surveillance and reporting.

V-2. Know the roles of federal and state regulatory agencies with regard to pesticide exposure control.

V-3. Report pesticide exposures as required.

Practice Skill VI: Providing Prevention Guidance and Education to Patients

VI-1. Engage in primary prevention strategies to promote health and prevent disease among patients.

VI-2. Work proactively with patients and the community to prevent exposure, ensure early detection, and limit effects of illness.

Practice Skill I: Taking an Environmental History

In the primary care setting, the recognition of pesticide poisoning begins with incorporating an environmental exposure history as a routine part of a focused medical history. Understanding how humans become exposed to pesticides is key. Health care providers should be aware of professions associated with use of pesticides (see Table 1 on page 37), as well as other incidental exposure possibilities at home, in schools, in the workplace, and elsewhere.

The exposure history may provide a clue to the broad category of pesticide to which an individual may have been exposed. The major categories of pesticides are insecticides, herbicides, fungicides, and rodenticides. Fumigants and disinfectants are also important as common pesticide exposures.

While some patients may recognize that they were exposed to a pesticide and that the exposure might be responsible for their symptoms, others will not have considered such a cause. Thus, the questions posed by the health care provider concerning the possibility of exposure represent the best chance to make such a connection.

Occasionally, a health care provider will be faced with a patient who believes he or she has been affected by a pesticide application when, in fact, there has been no exposure. Contacting the company or individual who applied the pesticide is the best choice, but if the contact is unavailable or unwilling to cooperate, the health care provider can seek assistance from other sources listed in the Resources section below.

Content

I-1. Understand the purposes and general principles for taking an environmental history.

- Purposes include:
  - Increase awareness of environmental/occupational factors
  - Improve diagnosis
  - Prevent disease and aggravation of conditions
  - Identify potential work-related environmental hazards, and/or environmental hazards in and around the home and community
  - Detect new associations
  - Improve rapport with patient
- Know the differences in exposure effects on different groups (e.g., children, adults, pregnant and lactating women, elderly).

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

- Recognize sign/symptoms for pesticides under consideration (see Practice Skill IV).
- Understand relationships of suspect exposures to health outcomes, including "hallmark" indicators of exposure.
- Recognize timing of suspected exposure to manifested signs and symptoms, including what makes signs/symptoms disappear or get worse.

I-2. Incorporate general environmental screening questions into routine patient histories.

- *Adults:*
  - What kind of work do you do?
  - Do you notice the problems you are having while you are at work? at home? in your community? in a specific location?
  - What causes symptoms to come and go?
  - Have you recently used pesticides, solvents, insecticides, weed killers?
  - What kinds of hobbies do you have?
  - Has your workplace been treated recently for insects, weeds, or other pest problems?
- *Children: (Questions asked of parent or guardian)*
  - Where does your child go to school, daycare, playgrounds?
  - Have any of these places been treated recently (e.g., sprayed) for insects, weeds, or other pest problems?
  - Does your child help with gardening activities?
  - Sources of food, water (e.g., well water), breast feeding of infant.

I-3. Be able to take a complete environmental exposure/health history for adults and children, covering occupational and non-occupational exposure factors.

- *Adults:*
  - Type of work including, how long on the job, kinds of work-exposures, any specific pesticide or work exposure (e.g., agricultural, extermination), sorting of contaminated clothing, use of PPE, hygiene practices of applicators, co-worker symptoms.
  - Home environment (age of home, characteristics of heating and ventilation system), use of pesticides in gardening or as an insecticide in the home, well water or source of drinking water, storage of chemicals, type of food bought/eaten, anyone else in family sick, hobbies (e.g., pottery, photography, painting, furniture stripping).
  - Community exposures including home location near industry, businesses (e.g., auto repair shops, dry cleaners), landfills, hazardous substance spills.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

- *Children: (Questions asked of parent or guardian)*
  - Where child goes to school, daycare, playground, play
  - Whether child helps with gardening activities
  - Hobbies
  - Sources of food, water (e.g., well water), breast feeding of infant
  - Parent's occupational exposure
  - Developmental issues
  - If parents have occupational exposure, is the clothing worn during application stored and washed separately from family clothing?

I-4. Develop network of resources.

- Know local and state experts or specialists who can be consulted for differential questions or exposure questions.
- Review pesticide label, or obtain information on pesticide labels related to health hazards and adverse effects. (See box on next page.)
- Contact patient's employer about potential work-related pesticide exposures and access to material safety data sheets, for information on health hazards and adverse effects. (See box below.)
- Develop network of resources for assessment tools.
- Compile Web resources for MSDS and label information.

Resources

- Reigart JR, Roberts JR. *Recognition and Management of Pesticide Poisonings*, 5th ed. Washington, D.C.: U.S. Environmental Protection Agency, 1999. The manual contains an exposure history questionnaire and cursory screening questions. Online at http://npic.orst.edu.rmpp:htm
- **National Pesticide Information Center.** Technical Pesticide Information, http://npic.orst.edu/tech.htm. **Includes links to factsheets on toxicology and active ingredients, health information databases, environmental and chemical properties databases; and product, label, and MSDS databases. For a list of sites with MSDS information, go to: www.phys.ksu.edu/area/jrm/Safety/msds.html**
- **Pesticide manufacturer:** Contact information should be on the label, or go to: http://npic.orst.edu/manuf.htm.
- **Agency for Toxic Substances and Disease Registry.** "Case Studies in Environmental Medicine, No. 26: Taking an Exposure History". www.atsdr.cdc.gov. Provides examples of case histories and suggested patient dialogues, includes an exposure history form.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

- **University of Maryland Pesticide Education and Assessment Program**. "Developing a Pesticide Exposure History", Pesticide Information Leaflet No. 25. May 1998. Provides guidance on taking exposure histories for both occupational and incidental pesticide exposures. http://pest.umd.edu/spatc/Leaflets/LeafletList.html. Other leaflets include: Comparing Symptoms of Heat Stress and Pesticide Poisoning, Cholinesterase Monitoring, Health Care Providers' Access to Pesticide Information, etc.

- **County Cooperative Extension Service** – Listed in the blue pages of telephone directories, or go to: http://npic.orst.edu/countyext.htm. County Extension personnel can help determine which pesticides may have been applied to a particular crop, and what activities might have taken place through which workers or others may have been exposed.

- **State Agromedicine Programs** – Agromedicine is a collaboration between medical professionals and state pesticide Extension and/or regulatory personnel to address health concerns of agriculture and forestry, and products associated with commodity production, including pesticides. Several states have active Agromedicine Programs; others are in the process of developing programs. Go to www.neetf.org/Health/Resources/healthcare.htm for a list of designated state contacts.

- **USDA Crop Profiles** – Provides information about pesticides used on a particular crop in a specific state in the United States. http://pestdata.ncsu.edu/CropProfiles/.

- **U.S. EPA Pesticide Management Resource Guide** – Contains directories and lists of pesticide information contacts: www.epa.gov/oppfead1/pmreg/index.html.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

Using the Pesticide Label as a Resource

The pesticide label is a legal document, and it is a violation of the law to use a pesticide in any manner inconsistent with the label. Every pesticide is required to bear a label that conforms to EPA standards.

The following items **must** appear on the label:

Ingredients statement – Name and percentage of each *active ingredient* and total percentage of *inert ingredients*. An inert ingredient is one for which no toxic activity against the pest is claimed, while the active ingredient is that component that actually controls the pest. (Although they are not toxic, inerts can cause health and environmental concerns.)

EPA registration number – Indicates that the pesticide label has been registered by EPA.

Establishment number – Identifies that facility where the product was made.

Formulation – Certain formulations are more likely to be absorbed through the skin or inhaled.

Signal word – Indicates level of acute toxicity. DANGER = extremely toxic (high potential for skin and eye irritation); DANGER/POISON = extremely toxic by ingestion; WARNING = moderately toxic; CAUTION = slightly toxic to relatively nontoxic.

Statement of practical treatment (first aid) – Indicates initial first aid practices to mitigate exposure. Indicates whether inducement of vomiting is recommended or contraindicated.

Personal protective equipment (PPE) – Clothing and/or equipment required to be worn when handling the pesticide.

Environmental hazards – Potential concerns regarding hazards to environment, including fish, avian, and bee toxicities.

Directions for use – Identifies crops/sites for application, pests controlled, method of application, rate of application, mixing directions, preharvest intervals, restricted entry intervals, etc.

Hazards to humans – Indicates which route of entry (mouth, skin, eyes, lungs) must particularly be protected and what specific actions should be taken to avoid acute effects from exposure.

Storage and disposal directions – Usually fairly general information such as "Store out of reach of children" and "Do not re-use container."

The following items **may** appear on a pesticide label

Restricted Use classification – A pesticide classified for restricted use has been determined by EPA to present potential hazard to humans and/or the environment even when used according to label directions. May be used only by or under supervision of a certified applicator.

Information on specific hazards posed by the pesticide – Labels may indicate that the product is a cholinesterase inhibitor (capable of binding to cholinesterase); causes allergic reactions or sensitization; or may cause chronic or delayed effects (carcinogenicity, reproductive effects, etc.) Note that such information was not required until relatively recently; older products may not carry this information even if it applies.

Using the Material Safety Data Sheet (MSDS) as a Resource

Commercial establishments using pesticides and other products are required to keep MSDS and make them available to workers or others potentially exposed to the substance, its diluted end product, or its residues. There is no standardized form for the MSDS. Items generally found on the MSDS are included below.

Chemical product identification – Name and percentage of each active ingredient and total percentage of inert ingredients. An inert ingredient is simply one for which no toxic activity against the pest is claimed, while the active ingredient is that component that actually controls the pest. Inert ingredients may also cause adverse effects in people and/or the environment.

Physical and chemical properties – Water solubility, vapor pressure, stability, melting and freezing points, etc.

Fire and explosion hazards – Flash point.

Toxicological information / Human health data – Identifies routes of exposure whereby toxicity may result. LD_{50} and or LC_{50} etc.

Regulatory levels and classifications

Threshold Limit Value (TLV) – 8-hour time-weighted average exposure that should not be exceeded.

Permissible Exposure Limit (PEL) – Time-weighted average concentration that must not be exceeded during any 8-hour work shift of a 40-hour work week.

Carcinogen classification – Known (Group A), probable (Group B), and possible (Group C) human carcinogens. Probable human carcinogens are further defined as Group B1 (probable human carcinogens with limited human evidence) or B2 (probable human carcinogens with sufficient evidence in animals but inadequate or no evidence in humans).

Personal protection recommendations – Note that this information applies to the concentrate only; refer to the product label to determine whether special equipment is needed when handling the diluted product.

Emergency and first aid procedures – Identifies cholinesterase inhibitors and provides treatment information for the physician.

Ecological or environmental hazards – Provides information on acute and chronic effects on wildlife.

Spills, fires, and accident procedures – Describes special precautions to be taken by emergency response personnel.

Storage and disposal directions – Directions may range from very specific to quite general.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

Practice Skill II:

Awareness of Community and Individual Pesticide Risk Factors

Content

II-1. Possess basic awareness of environmental aspects of communities in which patients live.

- Recognize differences in geographic dispersion of population in urban and rural living patterns and relationship to possible pesticide exposure. Recognize that different populations and communities have different exposures to pesticides.

- Use available community assessment data to begin an evaluation of the community (e.g., windshield surveys, citizen surveys, observation, newspaper, EPA website zipcode search, public library). Consider:

  - Location of homes near major industrial complexes or freeways
  - Air and water quality
  - Demographics of community members
  - What populations are at greatest risk (elderly, children, workers, pregnant and lactating women, other)?
  - Are there any cultural issues that may be predisposing to certain exposures?
  - Where do children play?
  - What community resources are available?
  - Where are high risk locales (farms, landfills, urban crowding)?
  - Which seasonal industries pose the greatest risk of exposure?
  - Are some population groups highly mobile or transient?
  - What are common problems related to pest infestation (rodents, mosquitos, ants, cockroaches)?

- Recognize potential environmental sources of exposure:

  - Recreational areas and fields
  - Yards
  - Golf courses
  - Schools and daycare facilities

II-2. Recognize high risk occupations for pesticide exposure.

The likelihood of pesticide poisoning depends in part on whether or not an individual is present in environments where pesticide exposure is likely to occur, such as:

- Farming, agriculture, migrant work, structural application
- Groundskeeping, schools, gardening (pesticide application): structural, agriculture, greenhouse, nurseries, golf courses, freeways, forestry, residential, schools
- Extermination services

Table 1 below lists numerous occupations that increase the chance for pesticide exposure, as well as some non-occupational sources that present an opportunity for pesticide exposure.

Table 1. Occupational and Non-Occupational Sources of Pesticide Exposure

Nonoccupational	Occupational	
Accident or intentional ingestion/suicide attempt	Aerial equipment maintenance	Marina workers
Food residues	Agricultural application	Medical personnel
Hazardous waste sites	Agronomists	Mixing and loading pesticides
Industrial spills	Building maintenance work	Park workers
Laundering of clothing worn in pesticide application	Emergency responders	Pesticide applicators
Residues from treated structures: houses, schools, office buildings	Entomologists	Plant pathologists
Residues in carpets and on domestic pets	Farm work	Research chemistry
Residues on treated lawns and landscapes	Firefighters	Sewer work
Termite control	Flaggers	Storage, warehouse work
Treated wood structures	Forestry workers	Structural application
Water residues	Formulating end product	Transportation
	Greenhouse, nursery, mushroom house work	Transporting pesticides
	Hazardous waste workers	Treating contaminated workers
	Landscapers	Vector control workers
	Livestock dippers and veterinarians	Wood treatment workers
	Manufacturing active ingredient	Work on highway or rail road rights of way

Adapted from: McConnell R. Chapter 87: Pesticides and related compounds. In: Rosenstock L, Cullen MR, eds. *Textbook of Clinical Occupational and Environmental Medicine*. Philadelphia, PA: W.B. Saunders Company; 1994.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

II-3. Develop community resource list.

The resource listing shown in Table 2 below summarizes in one place the various people and organizations that might be consulted in the event of a pesticide-related incident. They include:

- Basic hospital/emergency care
- Poison control/toxicology assistance
- Health care professional specialists
- University/public agency supports
- Resources specific to locale

Resources

- Rosenstock L, Cullen MR, eds. *Textbook of Clinical Occupational and Environmental Medicine.* Philadelphia, PA: W.B. Saunders Company; 1994.

- Links to online pesticide resources and directories are available through:
  - National Pesticide Information Center (EPA-funded): http://npic.orst.edu
  - EPA's Pesticide Management Resource Guide (PMReG): www.epa.gov/oppfead1/pmreg/index.html
  - NEETF's Pesticides Resource Library: www.neetf.org/Health/Resources/healthcare.htm

Table 2: Community Resources for Assistance with Pesticide Exposures

Resource	Tel	Fax	E-mail
Hospital			
Emergency Medical Service/ Rescue Squad			
Pharmacy			
Poison Control Center (www.npic.orst.edu/poison.htm)			
State Pesticide Regulatory Agency (www.npic.orst.edu/state1.htm)			
State Health Dept (www.apha.org/public_health/state.htm)			
Toxicology Division			
Environmental and Occupational Health			
National Poison Control Hotline	1-800-222-1222		
Local Health Dept			
Pesticide Division			
Toxicology Division			
University Toxicologists			
University Agriculture Dept			
EPA Regional Office			
OSHA Regional Office			
County Extension Service (look in blue pages in local telephone directory or http://npc.orst.edu/countyext.htm)			
Public Library			
Specialists:			
Occupational Medicine			
Agriculture			
National Institute for Occupational Safety and Health (NIOSH)			
National Pesticide Information Center (NPIC)	1-800-858-7378		npic@ace.orst.edu
Agency for Toxic Substances and Disease Registry (ATSDR)			
North American Agromedicine Consortium			

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

Practice Skill III: Knowledge of Key Health Principles

Content

III-1. Demonstrate key principles of environmental/occupational health, epidemiology, and population-based health.

- Understand determinants of persons, location, and time related to exposures:
  - Humans differ markedly in their responses dependent on genetics, metabolism, age, gender, size, co-exposure, behavior factors, routes of exposure (dermal, inhalation, ingestion).
  - Location of exposure includes workplace, home, community, and recreational sites. Understand sources of exposure, routes of exposure, clusters of cases.
  - Know the relationship of time, duration, and frequency of exposure to health outcomes, change in symptoms during the workday, week, weekends, vacation, etc.
  - Recognize that the effects of environmental exposures vary with a number of factors, including rate, type, concentration, and frequency of exposure.

- Be aware of sentinel health events that are unusual patterns of illnesses occurring in persons or community groups that can also act as a "red flag" for wider environmental health problems, such as pesticide poisoning.

- Recognize that many environmental diseases are related to a number of causes interacting together:
  - Understand the type and nature of exposure.
  - Acquire information about possible interactions including tobacco and alcohol.
  - Consider other health conditions that could be aggravated, such as asthma.

- Know exposure hazards (biological, chemical, enviromechanical, physical, psychosocial):
  - Biological/infectious hazards are caused by infectious/biological agents, such as bacteria, viruses, fungi, or parasites that may be transmitted via contact with infected patients or contaminated body secretions/fluids, contamination of drinking water supplies (improper sewage treatment and solid waste disposal), and through the air (enhanced by improperly cleaned heating and cooling systems).
  - Chemical hazards are various forms of chemicals that are potentially toxic or irritating to the body system, including medications, solutions, and gases. They include pesticides, (herbicides, fungicides, insecticides, etc.) and other household and industrial chemicals. Insecticides and herbicides used in large scale agriculture as well as in households, yards, and gardens, bring about numerous health effects ranging from nausea to long term neurological problems. Not only are many insecticides and herbicides acutely toxic, but some are highly suspect carcinogens.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

- Enviromechanical hazards are factors encountered in the work environment that cause or potentiate accidents, injuries, strain, or discomfort (e.g., poor equipment or lifting devices, slippery floors).
- Physical hazards are agents within the work environment, such as radiation, electricity, extreme temperatures, and noise that can cause tissue trauma.
- Psychosocial hazards are factors and situations encountered or associated with one's job or work environment and personal life experiences that create or potentiate stress, emotional stress, and/or interpersonal problems.

- Consider the impact of hazardous substances on reproductive events (pre-conception, fetal), lactation, and developmental milestones in children (newborn, infant/toddler, and school age).

- Recognize that others may be ill (work, family) and get timeline of health problems for these or consult public health authorities for help in evaluating exposures.

III-2. Understand the dose-response relationship.

- Assess recent and past exposures to toxic agents.

- Review interpretation of exposure monitoring data done by a professional (e.g., industrial hygienist).

- Recognize that in a dose-response relationship, as the dose increases, the severity of effect increases and could be fatal with pesticides.

- Understand that high dose exposures may manifest signs and symptoms almost immediately, making causal relationships more easily identified.

- Understand that low dose exposures over a period of time may manifest effects over a long latency period, often months or years (e.g., cancer, chemical sensitivity, neuropathy).

III-3. Understand measures of morbidity/mortality and study designs.

- Know incidence rates (i.e., number of new cases of illness/injury in the at-risk population during a defined period) and prevalence rates (i.e., all cases of illness/injury in the population at a point in time) of exposure and morbidity related to the home and community.

- Know the different types of study designs that can be utilized in investigations.

- Support or conduct investigations:

  - Differentiate study designs (case-control, cohort, cross-sectional studies) and when each is appropriate to use.
  - Understand ethical issues in using experimental designs or clinical trials in research.
  - Participate in study efforts as able.
  - Be alert to possible clustering of pesticide exposure cases through case identification, examination of dose-response relationships, and population disease rate increases.
  - Use epidemiologic data to link exposure and effect.

- Initiate opportunities for investigation of disease outbreaks through collaboration with public health, academic, governmental bodies (CDC, EPA, etc.).

Resources

LaDou J, ed. *Occupational and Environmental Medicine*, 2nd ed. Stamford, CT: Appleton & Lange; 1997.

Levy B, Wegmon D. *Occupational Health*. Boston, MA; 2000.

Rosenstock L, Cullen MR, eds. *Textbook of Clinical Occupational and Environmental Medicine*. Philadelphia, PA: W.B. Saunders Company; 1994.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

Practice Skill IV:
Clinical Management of Pesticide Exposure

Presented here is basic information on recognition and management of exposures to different types of pesticides that health care providers should be knowledgeable about. The information is not intended as a handbook or practical guide. Providers are referred to EPA's *Recognition and Management of Pesticide Poisonings* (Reigart and Roberts, 1999) for detailed clinical information. Providers should be able to:

- Recognize the signs and symptoms of pesticide exposures (both acute and chronic).
- Diagnose pesticide-related illness using appropriate testing procedures and environmental history (see Practice Skill I).
- Treat and manage health conditions associated with pesticide exposure. Refer patients to appropriate specialists and resources. Follow up appropriately with preventive guidance and clinical evaluation.

The material in this section is organized around a series of tables and checklists, as follows:

IV-1. Basic Management Techniques

- Table 3: Basic Clinical Management Techniques

IV-2. Signs and Symptoms of Pesticide Exposure

- Table 4: Cross-Reference of Pesticides and Classifications
- Table 5: Symptoms, Effects, and Special Management Considerations, by Pesticide Classification

IV-3. Carcinogenic and Reproductive Effects

- Table 6: Evidence of Carcinogenicity of Pesticides
- Table 7: Adverse Reproductive Outcomes

IV-4. Rapid Reference Tables for Common Pesticides: Signs, Symptoms, Evaluation, and Key Points of Treatment

- Table 8: Insecticides
- Table 9: Herbicides
- Table 10: Fumigants
- Table 11: Rodenticides
- Table 12: Fungicides
- Table 13: Disinfectants
- Table 14: Miscellaneous

IV-1. Basic Management Techniques

Basic management of acute pesticide poisoning includes eye, skin, and gastrointestinal decontamination, airway protection, and control of seizures. These techniques apply to most pesticide poisonings although there are special concerns for specific pesticides. Basic techniques are outlined in Table 3 below.

Table 3. Basic Clinical Management Techniques

Skin and Eye Decontamination

- Shower patient, hair to toe with soap and water to remove chemical
- Rubber gloves should be worn during decontamination
- Remember to clean skin folds and under fingernails
- Flush eyes with lots of clean water for 10 to 15 minutes
- Contaminated clothing should be removed promptly and bagged
- Avoid contact with contaminated clothing and body fluids

Airway Protection

- Ensure clear airway
- Suction oral secretions
- Administer oxygen unless not recommended (i.e., in paraquat and diquat poisoning)

Gastrointestinal Decontamination

No technique should be considered as routine management in pesticide poisonings, but can be considered as an option.

- **Gastric Lavage:**
  - Use only with ingestion of potentially life-threatening amount of poison and if it can be done *within 60 minutes of ingestion*
  - **Contraindicated** in hydrocarbon ingestion
- **Catharsis:**
  - Should be used as a single dose to reduce harmful effects
  - Sorbitol – 1-2 g/kg one time dose or
    Adults: 70% sorbitol, 1-2 mL/kg
    Children: 35% sorbitol, 1.5-2.3 mL/kg
  - **Contraindications** include absent bowel sounds, abdominal trauma or surgery, and intestinal perforation or obstruction. Also contraindicated in volume depletion, hypotension, electrolyte imbalance, and ingestion of a corrosive substance
  - Sorbitol is **not recommended** for poisoning with organophosphate, carbamates, arsenical diquat, or paraquat
- **Activated Charcoal:**
  - Most effective if used within 60 minutes of ingestion
  - Dosage:
    Adults 12 years and older: 25-100 g in 300-800 mL of water
    Children under 12 years: 25-50 g
    Infants under 20 kg: 1g/kg
  - **Contraindications** include unprotected airway, non-intact gastrointestinal tract, if there is increased risk for aspiration of a hydrocarbon pesticide
- **Syrup of Ipecac:**
  - Check pesticide label to determine if induced vomiting is contraindicated
  - Dosage:
    Adolescents and adults: 15-30 mL followed immediately with 240 mL of water
    Children 1-12 years: 15 mL preceded or followed by 120-240 mL of water
    Infants 6 months to 12 months: 5-10 mL preceded or followed by 120 to 240 mL of water
  - Dose may be repeated if no emesis in 20 to 30 minutes
  - **Contraindications** include diminished airway protective reflexes, ingestion of a corrosive material, ingestion of a substance likely to lead to life support within the next hour

Control of Seizures

- Most patients respond to benzodiazepines
- Lorazepam for status epilepticus:
  Adults: 2-4 mg/dose given IV over 2-5 minutes. Repeat as necessary to 8 mg in 12 hours
  Adolescents: Same as adult with 4 mg maximum
  Children under 12 years: 0.05-0.10 mg/kg IV over 2-5 minutes. Repeat as necessary 0.05 mg/kg 10-15 minutes after first dose. Maximum of 4 mg
- Diazepam is often used for organochlorine poisonings
  Adults: 5-10 mg IV, repeat every 5-10 minutes to maximum of 30 mg
  Children: 0.2-0.5 mg/kg IV every 5 minutes to maximum of 10 mg in children over 5 years and 5 mg in children under 5 years
- Phenobarbital may also be used
  Adults, children and infants: 15-20 mg/kg IV loading. 5 mg/kg IV every 15-30 minutes for a maximum of 30 mg/kg. Do not push drug faster than 1 mg/kg per minute

IV-2. Signs and Symptoms of Pesticide Exposure

Symptoms of pesticide poisoning and acute and long-term effects of exposure are outlined in this section (Table 5). This type of information should be at the finger-tips of practitioners. The material is organized by pesticide classification (insecticides, herbicides, fungicides, rodenticides, disinfectants, and miscellaneous).

Trade Names:

Table 4 can be used as a cross reference to determine the classification of common pesticides. Health care providers need to be aware that it is difficult to be sure of the exact ingredients in a product without referring to the actual product label. Over the years, trade names may change. In many cases (and especially true of products marketed to general consumers rather than those used in agriculture), a trusted trade name remains the same but the identity and/or composition (percentage) of the specific active and inert ingredients may change. Another problem is that some trade names (and many common names) sound similar to many users, which may lead a patient to inadvertently misidentify the pesticide to which he/she was exposed.

Relying on any cross-reference of trade and common or chemical names is risky, as the actual active ingredient to which the patient was exposed may differ entirely from the one(s) listed in the reference. If the product label is not available, and the patient can accurately remember the trade name, one potential source of information is the most recent edition of the *Farm Chemicals Handbook*, published annually by Meister Publishing Co., Willoughby, OH. The local Cooperative Extension office (listed under County Government in the telephone book) is another reliable source. Pesticide products aimed at the consumer market are especially difficult to identify without a label, as their trade names are generally are not included in reference documents, partly due to the frequency with which these products change.

Table 4: Cross-Reference of Pesticides and Classifications

Pesticide	Classification	
Aldicarb	Insecticide	Carbamate
Aldrin	Insecticide	Organochlorine
Arsenic	Miscellaneous	
Arsine gas	Miscellaneous	
Bendiocarb	Insecticide	Carbamate
Boric acid	Insecticide	
Cadmium	Fungicide	
Calcium cyanamide	Miscellaneous	
Carbaryl	Insecticide	Carbamate
Carbofuran	Insecticide	Carbamate
Cationic detergents	Disinfectant	
Chlordane	Insecticide	Orgahochlorine
Chlordecone	Insecticide	Organochlorine
Chlorpyrifos	Insecticide	Organophosphate
Copper	Fungicide	
Creosote	Miscellaneous	
Cyanide	Fumigant	
DDT	Insecticide	Organochlorine
DEET	Insecticide	
Diazinon	Insecticide	Organophosphate
2,4-D	Herbicide	Chlorophenoxy
Dichlorvos	Insecticide	Organophosphate
Dieldrin	Insecticide	Organochlorine
Dinitrocresol	Herbicide	
Diquat	Herbicide	
Endosulfan	Insecticide	Organochlorine
Endothall	Miscellaneous	
Endrin	Insecticide	Organochlorine
Ethion	Insecticide	Organophosphate
Ethyl parathion	Insecticide	Organophosphate
Ethylene oxide	Fumigant	
Fenvalerate	Insecticide	Pyrethroid
Fluoride	Insecticide	
Formaldehyde	Fumigant	
Glutaraldehyde	Disinfectant	
Heptachlor	Insecticide	Organochlorine
Lindane	Insecticide	Organochlorine
Malathion	Insecticide	Organophosphate
Metaldehyde	Miscellaneous	
Methamidophos	Insecticide	Organophosphate
Methomyl	Insecticide	Carbamate
Methyl mercury	Fungicide	
Methyl parathion	Insecticide	Organophosphate
Naphthalene	Fumigant	
Nicotine	Insecticide	
Nitrophenol	Herbicide	
Organotins	Fungicide	
Paraquat	Herbicide	
Pentachlorophenol	Herbicide	
Permethrin	Insecticide	Pyrethroid
Phenol	Disinfectant	
Phosphine gas	Fumigant	
Pine oil	Disinfectant	
Promecarb	Insecticide	Carbamate
Propetamphos	Insecticide	Organophosphate
Propoxur	Insecticide	Carbamate
Pyrethrin	Insecticide	
Sodium hypochlorite	Disinfectant	
Strychnine	Rodenticide	
Thallium	Rodenticide	
Toxaphene	Insecticide	Organochlorine
Trichlorfon	Insecticide	Organophosphate
Warfarin	Rodenticide	
Zinc phosphide	Rodenticide	

Inerts:
Headaches, irritation, and general malaise are the most likely symptoms of acute overexposure to inert ingredients, especially those derived from petroleum sources. Neurological damage is possible from extremely large exposure to some inerts. Treating physicians should contact the pesticide registrant (a contact number must be listed on the pesticide label) for information on the specific inert ingredients in a particular product.

Table 5: Symptoms, Effects, and Special Management Considerations, by Pesticide Classification

Organophosphates — INSECTICIDES

Acute symptoms
- Anorexia
- Nausea/vomiting
- Abdominal cramps
- Diarrhea
- Chest tightness
- Increased salivation and lacrimation
- Miosis/blurred vision
- Sweating
- Bradycardia
- Bowel/urinary incontinence
- Muscle twitching
- Hypertension
- Hyperglycemia
- Tachycardia

Possible long term chronic effects
- Weakness
- Malaise
- Headache
- Lightheadedness
- QT prolongation and torsade de pointes
- Delayed polyneuropathy (weakness, paralysis, paresthesias of extremities)- rare

Carcinogenicity
- Some epidemiologic studies have reported associations between some organophosphate pesticides and Non-Hodgkin's lymphoma, leukemia, and lung cancers

Potential reproductive adverse outcomes
- No human data
- Limited animal data

Evaluation
- Fasciculations with miosis
- Plasma pseudocholinesterase
- Red blood cell acetylcholinesterase

Special management considerations
- Tissue oxygenation is essential prior to administering atropine to minimize risk of ventricular fibrillation
- Be sure toxicity is not due to severe **pyrethroid** poisoning
- Atropine sulfate
- Pralidoxime
- **Contraindications:** morphine, succinylcholine, theophylline, phenothiazines, reserpine

Carbamates — INSECTICIDES

Acute symptoms
- Anorexia
- Nausea/vomiting
- Abdominal cramps
- Diarrhea
- Chest tightness
- Increased salivation and lacrimation
- Miosis/blurred vision
- Sweating
- Bradycardia
- Bowel/urinary incontinence
- Muscle twitching
- Hypertension
- Hyperglycemia
- Tachycardia

Possible long term chronic effects
- Weakness
- Malaise
- Headache
- Lightheadedness
- QT prolongation and torsade de pointes

Carcinogenicity
- Not considered carcinogenic

Potential reproductive adverse outcomes
- Carbaryl has been classified as a male reproductive hazard
- Carbaryl crosses the placenta
- High level exposure in pregnant women to Aldicarb resulted in premature stillborn infants

Evaluation
- Fasciculations with miosis
- Plasma pseudocholinesterase
- Red blood cell acetylcholinesterase

Special management considerations
- Tissue oxygenation is essential prior to administering atropine to minimize risk of ventricular fibrillation
- Atropine sulfate
- Pralidoxime not indicated
- **Contraindications:** morphine, succinylcholine, theophylline, phenothiazines, reserpine

Organochlorines — INSECTICIDES

Acute symptoms
- Headache
- Nausea
- Dizziness
- Incoordination
- Confusion
- Tremor
- Paresthesias

Possible long term chronic effects
- Anxiety
- Tremor
- Opsoclonus
- Personality change
- Oligospermia
- Pleuritic and joint pains
- Weight loss
- Liver disease

Evaluation
- Appropriate history of exposure

Special management considerations
- **Contraindications:** atropine, epinephrine, other adrenergic amines due to enhanced myocardial irritability, animal or vegetable oils or fats by mouth

Pyrethrum/Pyrethroids — INSECTICIDES

Acute symptoms
- Salivation
- Nausea and vomiting
- Diarrhea
- Irritability
- Tremor
- Incoordination
- Paresthesias
- Pulmonary edema
- Muscle fasciculation
- Seizures and death
- Asthma
- Contact dermatitis

Possible long term chronic effects
- Allergic rhinitis
- Asthma
- Contact dermatitis

Evaluation
- Appropriate history of exposure

Special management considerations
- Be sure toxicity is not due to organophosphates or carbamates

DEET — INSECTICIDES

Acute symptoms
- Headache
- Restlessness
- Irritability
- Ataxia
- Rapid loss of consciousness
- Hypotension
- Seizures

Possible long term chronic effects
- Flaccid paralysis and areflexia

Boric acid — INSECTICIDES

Acute symptoms
- Nasal irritation
- Mucous membrane dryness
- Cough
- Shortness of breath
- Chest tightness
- Beefy red skin rash on palms, soles, buttocks, scrotum
- Nausea
- Diarrhea
- Hypothermia

Possible long term chronic effects
- Persistent vomiting
- Abdominal pain
- Lethargy
- Headache

Evaluation
- Appropriate history of exposure
- Urine borate levels

Fluorides — INSECTICIDES

Acute symptoms
- Thirst
- Abdominal pain
- Vomiting
- Diarrhea
- Cardiac arrhythmia and shock

Possible long term chronic effects
- Gastric mucosal hemorrhage, ulceration, erosions
- Hypocalcemia

Evaluation
- Appropriate history of exposure

Special management considerations
- Milk, calcium gluconate, or magnesium citrate

Nicotine — INSECTICIDES

Acute symptoms
- Salivation
- Sweating
- Dizziness
- Nausea and vomiting
- Diarrhea

Possible long term chronic effects
- Burning in mouth, throat
- Agitation
- Confusion
- Headache
- Abdominal pain

Evaluation
- Urine cotinine levels

Special management considerations
- Atropine for severe salivation, diarrhea or bradycardia

Chlorophenoxy compounds — HERBICIDES

Acute symptoms
- Skin and mucosal membrane irritation
- Burning sensations of nasopharynx and chest
- Cough
- Dizziness
- Peculiar odor on breath
- Vomiting
- Headache
- Diarrhea
- Confusion
- Bizarre and aggressive behavior

Possible long term chronic effects
- Hyperventilation
- Muscle weakness
- Peripheral neuropathy

Evaluation
- Chlorophenoxy compound urine levels

Paraquat — HERBICIDES

Acute symptoms
- Burning pain in mouth, throat, chest, and upper abdomen
- Bloody diarrhea
- Giddiness
- Headache
- Fever
- Myalgia
- Lethargy
- Pulmonary edema and early lung damage

Possible long term chronic effects
- Abdominal pain due to pancreatitis
- Proteinuria
- Hematuria
- Pyuria
- Azotemia
- Pulmonary fibrosis

Evaluation
- Urine dithionite test – blue color

Special management considerations
- Gastrointestinal decontamination with Bentonite, Fuller's Earth, or activated charcoal
- **No oxygen** unless severely hypoxic

Diquat — HERBICIDES

Acute symptoms
- Nervousness
- Irritability
- Restlessness
- Combativeness
- Disorientation
- Nonsensical statements
- Inability to recognize family/friends
- Burning pain in mouth, throat, chest, and upper abdomen
- Bloody diarrhea
- Giddiness
- Headache
- Fever
- Myalgia
- Lethargy

Possible long term chronic effects
- Proteinuria
- Hematuria
- Pyuria
- Azotemia

Evaluation
- Urine dithionite test – green color

Special management considerations
- Gastrointestinal decontamination with Bentonite, Fuller's Earth, or activated charcoal
- **No oxygen** unless severely hypoxic

Pentachlorophenol — HERBICIDES

Acute symptoms
- Irritation of nose, throat and eyes
- Sweating
- Weakness
- Dizziness
- Anorexia
- Intense thirst
- Hyperthermia
- Tremor
- Shortness of breath
- Chest tightness

Possible long term chronic effects
- Contact dermatitis
- Diffuse urticaria or chloracne

Evaluation
- Blood and urine pentachlorophenol levels (ratio of blood to urine is 1:2.5)

Special management considerations
- **Antipyretic therapy with salicylates is strongly contraindicated**
- Reduce body temperature with sponge baths and fans

Nitrophenols/Dinitrocresols — HERBICIDES

Acute symptoms
- Profuse sweating
- Thirst
- Hyperthermia
- Headache
- Confusion
- Malaise
- Restlessness
- Tachycardia
- Tachypnea

Possible long term chronic effects
- Yellow staining of skin, sclera, and urine
- Renal failure
- Jaundice
- Weight loss

Evaluation
- Appropriate history of exposure
- Blood dinitro-ortho-cresol

Special management considerations
- **Antipyretic therapy with salicylates is strongly contraindicated**
- Reduce body temperature with sponge baths and fans
- **Atropine is absolutely contraindicated**
- While not contraindicated, NSAIDs and acetaminophen will not likely have much effect

Coumarins — RODENTICIDES

Acute symptoms
- Nosebleeds
- Bleeding gums
- Extensive ecchymosis
- Fatigue
- Dyspnea on exertion

Possible long term chronic effects
- Fatigue
- Dyspnea on exertion

Evaluation
- Prothrombin time

Special management considerations
- Vitamin K1 (phytonadione)

Strychnine — RODENTICIDES

Acute symptoms
- Convulsions

Evaluation
- Appropriate history of exposure

Special management considerations
- Diazepam for seizure control

Thallium — RODENTICIDES

Acute symptoms
- Abdominal pain
- Nausea and vomiting
- Bloody diarrhea
- Stomatitis
- Salivation
- Headache
- Lethargy
- Muscle weakness
- Painful paresthesias
- Tremor
- Ptosis
- Ataxia

Possible long term chronic effects
- Alopecia
- Ileus
- Hypertension
- Ventricular arrythmias

Evaluation
- 24-hour urine excretion

Special management considerations
- Chelating agents are **not** recommended

Phosphides — RODENTICIDES

Acute symptoms
- Nausea and vomiting
- Excitement
- Chills
- Chest tightness
- Dyspnea
- Cough
- Delirium
- Convulsions
- Tetany due to hypocalcemia
- Anuria
- Ventricular arrythmias

Possible long term chronic effects
- Hepatic failure with jaundice and hemorrhage

Evaluation
- Appropriate history of exposure
- Foul rotten fish odor to vomitus, feces, and sometimes breath

Special management considerations
- Well-ventilated room in case phosphine gas evolves from emesis, lavage fluid, and feces

Organomercury compounds — FUNGICIDES

Acute symptoms
- Metallic taste in mouth
- Numbness and tingling of digits and face
- Tremor
- Headache
- Fatigue
- Emotional lability
- Difficulty thinking

Possible long term chronic effects
- Incoordination
- Slurred speech
- Loss of position sense
- Hearing loss
- Constriction of visual fields
- Spasticity/rigidity of muscle movements
- Deterioration of mental capacity

Evaluation
- Blood mercury level
- 24-hour urine mercury

Special management considerations
- Chelation with Succimer

Copper compounds — FUNGICIDES

Acute symptoms
- Metallic taste
- Nausea and vomiting
- Epigastric pain
- Jaundice
- Hepatomegaly

Possible long term chronic effects
- Hepatomegaly
- Hemolysis
- Methemoglobinemia
- Renal failure

Evaluation
- Appropriate history of exposure

Special management considerations
- Dilute with water or milk

Organotin compounds — FUNGICIDES

Acute symptoms
- Headache
- Nausea and vomiting
- Dizziness
- Photophobia
- Mental disturbances

Possible long term chronic effects
- Epigastric pain
- Hyperglycemia

Evaluation
- Appropriate history of exposure

Special management considerations
- Chelation not effective

Cadmium compounds — FUNGICIDES

Acute symptoms
- Eye, nose, throat irritation
- Fever
- Cough
- Malaise
- Headaches
- Abdominal pain
- Tenesmus

Possible long term chronic effects
- Chemical pneumonitis

Evaluation
- Blood and urine cadmium levels

Special management considerations
- Chelation with EDTA
- Dimercaprol (BAL) is not recommended

Cyanide — FUMIGANTS

Acute symptoms
- Pink/red skin color
- Bitter almond odor to breath
- Constriction and numbness of throat
- Jaw stiffness
- Salivation
- Nausea and vomiting
- Lightheadedness
- Apprehension

Possible long term chronic effects
- Violent convulsions

Evaluation
- Blood and urine thiocyanate

Special management considerations
- Continuous oxygen administration
- Cyanide antidotes; amyl nitrite, sodium nitrite, and sodium thiosulfate

Naphthalene — FUMIGANTS

Acute symptoms
- Eye, nose, and throat irritation
- Headache
- Dizziness
- Nausea and vomiting

Possible long term chronic effects
- Hemolysis

Evaluation
- Blood alpha naphthol level

Special management considerations
- Examine plasma for evidence of hemolysis

Phosphine gas — FUMIGANTS

Acute symptoms
- Fatigue
- Nausea
- Headache
- Dizziness
- Thirst
- Cough
- Shortness of breath
- Tachycardia
- Chest tightness
- Paresthesia
- Jaundice

Possible long term chronic effects
- Pulmonary edema
- Odor resembling decaying fish
- Ventricular arrythmias

Evaluation
- Appropriate history of exposure

Special management considerations
- Magnesium sulfate may decrease likelihood of fatality

Formaldehyde — FUMIGANTS

Acute symptoms
- Eye, nose, throat irritation
- Laryngeal edema
- Tracheobronchitis

Possible long term chronic effects
- Allergic dermatitis
- Asthma-like symptoms

Evaluation
- Appropriate history of exposure

Ethylene oxide — FUMIGANTS

Acute symptoms
- Headache
- Nausea
- Vomiting
- Weakness
- Persistent cough

Possible long term chronic effects
- Pulmonary edema
- Cardiac arrythmias

Evaluation
- Appropriate history of exposure

Glutaraldehyde

DISINFECTANTS

Acute symptoms
- Eye, nose, throat irritation
- Gastrointestinal irritation
- Diarrhea
- Rhinitis

Evaluation
- Appropriate history of exposure

Sodium hypochlorite

DISINFECTANTS

Acute symptoms
- Eye, nose, throat irritation

Evaluation
- Appropriate history of exposure

Special management considerations
- Dilution with water or milk
- **Do not give acids** due to risk of generating chlorine gas

Cationic detergents

DISINFECTANTS

Acute symptoms
- Eye irritation
- Skin rash and irritation
- Corneal and skin burns
- Burns to lips, oral mucosa, esophagus, and stomach
- Vomiting
- Diarrhea
- Abdominal pain

Evaluation
- Appropriate history of exposure

Special management considerations
- Gastrointestinal decontamination is **contraindicated**

Phenols

DISINFECTANTS

Acute symptoms
- Nausea
- Vomiting
- Diarrhea
- Eye and skin burns
- Corrosive injury to mouth and upper gastrointestinal tract

Possible long term chronic effects
- Hypotension
- Myocardial failure
- Pulmonary edema
- Liver and renal toxicity
- Methemoglobinemia
- Hemolysis
- Contact dermatitis

Evaluation
- Appropriate history of exposure

Special management considerations
- Gastrointestinal decontamination is **contraindicated**

Pine oil

DISINFECTANTS

Acute symptoms
- Eye, nose, throat irritation
- Gastrointestinal irritation

Possible long term chronic effects
- Respiratory distress
- Renal failure
- Myoglobinuria

Evaluation
- Appropriate history of exposure

Special management considerations
- Induced emesis is contraindicated

IV-3. Carcinogenic and Reproductive Effects

The likelihood of pesticide exposure causing cancer is dependent on the frequency, duration, and magnitude or intensity of exposure as well as on latency (the length of time from exposure to onset of disease). The potential for carcinogenicity shown in Table 6 is based on EPA's classification system. The EPA classification system and its definitions are as follows:

- Group A - Carcinogenic to Humans. Pesticides in this group have sufficient evidence from epidemiologic studies to support a causal relationship between exposure to the agent and cancer. All uses of these pesticides have been cancelled except coal tar and chromium as a wood preservative and ethylene oxide as a fumigant.

- Group B – Probable human carcinogen. This group is divided into subgroups B1 and B2:

  - B1 – Pesticides in this subgroup have sufficient evidence for carcinogenicity from animal studies, but limited evidence from epidemiologic studies. All uses of these pesticides have been cancelled except creosote as a wood preservative and formaldehyde.
  - B2 – Pesticides in this subgroup have sufficient evidence from animal studies with inadequate or no evidence from epidemiologic studies. All or most of the uses from this class have been cancelled or were never approved; others have various food and other uses.

- C – Possible human carcinogen. Pesticides in this group have limited evidence of carcinogenicity in animals and no human data.

- D – Not classifiable as to human carcinogenicity. Pesticides in this group do not have adequate human and animal evidence for carcinogenicity or no data are available.

- E – Evidence on non-carcinogenicity for humans. Pesticides in this group show no evidence for carcinogenicity in at least 2 animal tests in different species or in adequate epidemiologic and animal studies.

This list of pesticides in Table 6 is not exhaustive and it changes as more data are acquired. Additional information on the EPA carcinogenicity classification of pesticides can be obtained from the EPA's Science Information Management Branch, Health Effects Division, Office of Pesticide Programs.

Table 6: Evidence of Carcinogenicity of Selected Pesticides

Pesticide	Carcinogenicity Classification
Insecticides	
Organophosphates	
Dichlorvos	C
Carbamates	
Aldicarb	E
Carbaryl	C
Organochlorines	
Aldrin	B2
Chlordane	B2
Chlordecone	B2
Dieldrin	B2
Heptachlor	B2
DDT	B2
Lindane	B2
Toxaphene	B2
Pyrethrins/pyrethroids	
Permethrin	C
Fenvalerate	E
Herbicides	
Pentachlorophenol	B2
Acrolein	B2
Acifluorfen	B2
Fumigants	
Formaldehyde	B1
Ethylene oxide	B1
Fungicides	
Captan	B2
Maneb	B2
Cadmium compounds	B1
Miscellaneous	
Arsenic	A
Creosote	B1

Source: U.S. Environmental Protection Agency, *Chemicals Evaluated for Carcinogenic Potential*, Science Information Management Branch, Health Effects Division, Office of Pesticide Programs, 1994.

Table 7 outlines reproductive outcomes for certain pesticides for which there are either animal or human data. The information in this table is suggestive only and should not be considered conclusive.

Table 7: Adverse Reproductive Outcomes*

Pesticide	Sperm/testicular abnormalities	Infertility	Spontaneous abortion	Preterm delivery	Fetal death	Congenital abnormalities	Found in breast milk	Postnatal effects
Insecticides								
Organophosphates								
Chlorpyrifos	A		A				A	
Diazinon	A				A	A	A	
Malathion	A					A	A	
Carbamates								
Aldicarb					H			
Carbaryl	H, A					A	A	A
Organochlorines								
Chlordecone	H, A		A					A
DDT		H					H	A
Lindane	A		A				H	
Pyrethrins/pyrethroids								
Permethrin								A
Cypermetherin	A							A
Cyfluthrin								A
Herbicides								
Chlorophenoxy compounds								
Dichlorophenoxy acetic acid	H				A	A		A
Pentachlorophenol								
Fumigants								
Formaldehyde	A		H					H, A
Ethylene Oxide	A	A	H					
Fungicides								
Organomercury compounds								
Methyl mercury chloride	A					H	H	H
Cadmium compounds	A, H					A	H	
Miscellaneous								
Arsenic	A				H	A	H	

*A = animal data; H = at least some human data.

Source: Frazier LM and Hage ML. *The Reproductive Hazards of the Marketplace*. New York: Van Nostrand Reinhold, 1998.

IV-4. Rapid Reference Tables for Common Pesticides

Tables 8-14 can be used as rapid reference tables for signs and symptoms of common exposures, as well as evaluation tips and key points of treatment. Practitioners can identify common pesticides that may explain a patient's symptoms or physical findings and then identify basic evaluation and treatment recommendations. The following points should be kept in mind in using these tables:

- Included are those pesticides most often involved in symptomatic illness, based on 1996 data from the American Association of Poison Control Centers' Toxic Exposure Surveillance System.
- The symptoms and signs listed are not specific to pesticide poisoning, but can be manifestations of other illness or exposures.
- An individual exposed to a pesticide listed in the tables may present with signs and symptoms not listed in the tables.
- The main purpose of this reference is to provide the practitioner with hints that may indicate additional investigation or prompt referral for further evaluation and treatment.

For further information, refer to EPA's *Recognition and Management of Pesticide Poisonings* for more in-depth discussion of toxicology, poisoning confirmation, and treatment for these and other pesticides.

Table 8: Rapid Reference Tables: Insecticides

Signs and Symptoms	Organophosphates	N-Methyl Carbamate	Solid Organochlorine	DEET	Boric Acid	Fluorides	Pyrethrins/pyrethroids	Nicotine
General								
Hyperthermia					X			
Thirsty					X	X		
Anorexia	X	X			X	X		X
Salty, soapy taste in mouth								
Skin								
Contact dermatitis				X			X	
Beefy red palms, soles					X			
Urticaria				X		X		
Pallor			X			X		
Cyanosis								X
Sweating, diaphoresis	X	X						X
Eye								
Tearing	X	X					X	
Diplopia	X	X						X
Miosis	X	X						X
Dilated pupils						X		
Nervous system								
Paresthesias	X		X			X	X	X
Headache	X	X	X		X	X		X
Behavioral-mood disturbances	X	X	X			X		X
Depression, stupor, coma	X	X				X		
Respiratory failure	X	X			X	X		
Seizures/convulsions	X	X	X	X	X	X		X
Muscle twitching	X	X						X
Tetany, carpopedal spasms						X		
Tremor	X	X			X			X
Incoordination/ataxia	X	X	X					X
Paresis, muscle weakness	X	X						X
Hypotension, shock					X			X
Hypertension	X							X
Cardiovascular								
Cardiac arrhythmias	X	X	X					X
Bradycardia	X							X
Tachycardia	X							
Respiratory								
Upper respiratory irritation					X			
Runny nose	X	X					X	
Pulmonary edema	X	X					X	
Dyspnea	X	X					X	X
Gastrointestinal								
Nausea/vomiting	X	X			X	X		X
Diarrhea	X	X			X	X	X	X
Abdominal pain	X	X			X	X		X
Salivation	X	X				X		X
Kidney								
Oliguria, polyuria						X		
Acute renal failure					X	X		
Ketonuria								
Blood								
Hypocalcemia						X		
Hyperkalemia						X		
Elevated LDH, GOT, GPT, ALT, AST, alkaline phosphatase			X					
Depressed RBC acetylcholinesterase and plasma pseudocholinesterase	X	X						

Table 8: Rapid Reference Tables: Insecticides *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Organophbsphate	■Plasma pseudocholinesterase ■RBC acetylcholinesterase	■Adequate tissue oxygenation ■Atropine ■Pralidoxime ■Skin and gastrointestinal decontamination
N-Methyl Carbamate	■Plasma pseudocholinesterase ■RBC acetylcholinesterase	■Adequate tissue oxygenation ■Atropine ■Pralidoxime of little value ■Skin and gastrointestinal decontamination
Solid Organochlorine	No routine test available	■Supportive ■Control seizures with Diazepam
DEET	No routine test available	■Skin and gastrointestinal decontamination ■Control seizures with Diazepam
Boric Acid	Urine borate	■Skin and gastrointestinal decontamination
Fluorides	■Blood fluoride ■Serum electrolytes	■Skin and gastrointestinal decontamination ■Calcium and magnesium administration
Pyretrins/pyrethroids	No routine test available	■Antihistamines ■Be sure that symptoms are not due to organophosphate or carbamate toxicity ■Eye, skin and gastrointestinal decontamination ■Control seizures with Diazepam
Nicotine	Urine cotinine	■Skin and gastrointestinal decontamination

Table 9: Rapid Reference Tables: Herbicides

Signs and Symptoms	Chlorophenoxy compounds	Paraquat	Diquat	Pentachlorophenol	Nitrophenols/ dinitrocresols
General					
Hyperthermia/fever, pyrexia	X			X	X
Paresthesias					
Myalgias	X	X		X	X
Thirst				X	X
Anorexia					
Skin					
Irritation, rash, blistering, erosion	X	X	X	X	
Contact dermatitis		X			X
Flushing					
Urticaria					
Cyanosis		X			X
Yellow stain					
Jaundice		X	X		
Loss fingernails				X	
Sweating, diaphoresis					
Eye					
Conjunctivitis		X	X	X	X
Tearing				X	X
Yellow sclera					
Keratitis		X			
Nervous system					
Headache		X	X	X	X
Behavioral, mood disturbances			X	X	X
Depression, stupor, coma					
Respiratory failure	X	X	X	X	X
Seizures, convulsions	X				
Muscle twitching	X				
Myotonia	X				
Cardiovascular					
Tachycardia				X	X
Respiratory		X			
Upper respiratory irritation	X				
Runny nose	X				
Pulmonary edema		X	X		
Pulmonary consolidation		X		X	X
Dyspnea		X			
Gastrointestinal					
Nausea/vomiting	X	X	X	X	
Diarrhea	X	X	X		
Abdominal pain		X	X		
Stomatitis			X		
Ileus					
Kidney					
Acute renal failure	X	X	X	X	X
Blood					
Elevated LDH, GOT, GPT, ALT/AST, alkaline phosphatase	X			X	X

Table 9: Rapid Reference Tables: Herbicides *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Chlorophenoxy compounds	Blood and urine chlorophenoxy compound	■ Persons with chronic skin disease or known sensitivity to chlorophenoxy herbicides should avoid use ■ Skin and gastrointestinal decontamination ■ Use respiratory protection if symptoms develop after use
Paraquat	Urine Dithionite test for paraquat	■ Skin, eye decontamination ■ GI decontamination with Bentonite, Fuller's Earth or activated charcoal ■ **DO NOT administer oxygen unless severely hypoxic** ■ Pain management
Diquat	Urine Dithionite test for diquat	■ Skin, eye decontamination ■ GI decontamination with Bentonite, Fuller's Earth or activated charcoal ■ **DO NOT administer oxygen unless severely hypoxic** ■ Pain management
Pentachlorophenol	■ Total pentachlorophenol in urine ■ Free pentachlorophenol in plasma	■ No antidote, supportive treatment ■ Salicylates for fever control is **strongly contraindicated** ■ Control hyperthermia with sponge baths and fans ■ Decontaminate eyes, skin, hair, clothing ■ Consider GI decontamination after ingestion if within 1 hour of poisoning ■ High calorie, high vitamin diet to restore fat and carbohydrates during recovery
Nitrophenols/dinitrocresols	Blood nitrophenol and nitrocresol	■ No specific antidote ■ Hyperthermia control with sponge baths and fans ■ Salicylates for fever control is **strongly contraindicated** ■ **Atropine absolutely contraindicated** ■ Decontaminate skin, hair, clothing ■ High calorie, high vitamin diet to restore fat and carbohydrates during recovery

Table 10: Rapid Reference Tables: Fumigants

Signs and Symptoms	Cyanide	Naphthalene	Phosphine gas	Formaldehyde	Methyl bromide	Ethylene oxide
General						
Hyperthermia		X				
Chills			X			
Fever	X			X		
Skin						
Irritation, rash, blistering, or erosion				X		X
Dermal sensitization				X		X
Pallor	X	X	X	X		X
Jaundice			X			
Sweating, diaphoresis		X				
Eye						
Conjunctivitis		X		X		X
Yellow sclerae			X			
Miosis	X					
Dilated pupils	X					
Unreactive pupils	X					
Nervous system						
Headache			X			
Behavioral mood disturbances	X		X			
Depression, stupor						
Coma, respiratory failure			X			
Seizures, convulsions	X		X			
Hypotension, shock			X			
Cardiovascular						X
Cardiac arrhythmias	X		X			
Brady cardia	X					
Respiratory						
Upper respiratory irritation	X	X		X		X
Pulmonary edema			X			
Dyspnea	X					
Gastrointestinal	X	X	X			X
Nausea, vomiting	X					
Salivation	X					
Liver						
Enlargement			X			
Kidney						
Oliguria		X	X			
Acute renal failure						
Hemoglobinuria		X				
Blood						
Hemolysis		X				
Methemoglobinemia	X					
Hyperkalemia		X				
Anemia		X				
Elevated LDH, GOT, GPT, ALT/AST, alkaline phosphatase			X			

Table 10: Rapid Reference Tables: Fumigants *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Cyanide	Urine thiocyanate	■ Prompt administration of oxygen ■ Antidotes: amyl nitrite → sodium nitrite → sodium thiosulfate ■ GI decontamination if poisoning < 1 hour ■ Avoid ipecac ■ Eye/skin decontamination
Naphthalene	Urine alpha-naphthol	■ GI decontamination for ingestion if poisoning < 1 hour ■ Fresh air ■ Skin decontamination ■ Fresh air ■ Eye/skin decontamination ■ Fresh air ■ Eye/skin decontamination ■ Fresh air ■ Eye/skin decontamination
Phosphine gas	No test available	
Formaldehyde	No test available	
Methyl bromide	Serum bromide ion	
Ethylene oxide	No test available	

Table 11: Rapid Reference Table: Rodenticides

Signs and Symptoms	Coumarins	Strychnine	Thallium	Zinc phosphide
General				
Hyperthermia			X	
Thirst				X
Skin				
Pallor	X			
Cyanosis		X		
Jaundice				X
Ecchymosis	X			
Loss of hair			X	
Brittle nails, white striations			X	
Eye				
Ptosis			X	
Optic atrophy			X	
Nervous system				
Paresthesias			X	X
Headache			X	
Behavioral-mood disturbances			X	
Seizures/convulsions			X	
Tetany, carpopedal spasms				X
Tremor				
Incoordination/ataxia			X	
Hypotension, shock			X	X
Hypertension			X	
Cardiovascular				
Cardiac arrythmias			X	X
Respiratory				
Pulmonary edema				X
Gastrointestinal				
Nausea/vomiting			X	X
Diarrhea	X			X
Abdominal pain	X		X	X
Ileus			X	
Kidney				
Oliguria				X
Blood				
Hypoprothrombinemia	X			X
Hypocalcemia			X	X
Elevated LDH, GOT, GPT, ALT/AST, alkaline phosphatase				X

Table 11: Rapid Reference Table: Rodenticides *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Coumarins	Prothrombin time	■ Determine quantity ingested: if no more than a mouthful or two, treatment likely not necessary ■ Vitamin K for increased prothrombin time ■ GI decontamination if ingested within a few hours ■ Ferrous sulfate during recovery after more severe poisoning
Strychnine	No test available	■ Control seizures with Diazepam ■ GI decontamination if ingested < 1 hour ■ Avoid fluid overload ■ Monitor ECG ■ Calcium gluconate for hypocalcemia
Thallium	Serum and urine thallium	■ GI decontamination if ingestion < 1 hour ■ Seizure control ■ Chelating agents not recommended
Zinc phospide	■ Foul, rotten fish odor of vomitus, feces, breath ■ Serum phosphate and calcium	■ Skin decontamination. Make sure all particles of phosphorus have been removed ■ Phosphine gas may be formed from vomitus, lavage fluid and feces. Individual's room should be well-ventilated ■ Anyone attending patient should wear gloves

Table 12: Rapid Reference Tables: Fungicides

Signs and Symptoms	Organomercury Cmpds	Captan/Folpet	Dithiocarbamates	Organotin Cmpds	Cadmium Cmpds
General					
Hyperthermia					X
Metallic taste in mouth	X				
Skin					
Irritation, rash, blistering, erosion	X	X		X	X
Cyanosis					X
Jaundice					X
Sweating, diaphoresis	X				
Eye					
Conjunctivitis		X		X	
Constricted visual fields	X				
Photophobia					
Nervous System					
Paresthesias	X				X
Headache	X	X		X	X
Behavioral, mood disturbances	X			X	
Seizures, convulsions				X	
Muscle twitching	X				
Tremor	X				
Incoordination, ataxia					
Paralysis, paresis, muscle weakness	X				
Hearing loss			X		
Hypotension, shock					
Cardiovascular					
Cardiac arrhythmias					
Respiratory					
Upper respiratory irritation		X	X	X	X
Runny nose		X	X		
Pulmonary edema					X
Pulmonary consolidation					X
Dyspnea					X
Gastrointestinal	X	X	X	X	X
Nausea, vomiting					X
Diarrhea			X	X	X
Abdominal pain			X		
Stomatitis					X
Salivation					
Liver					
Enlargement			X		
Kidney					
Hematuria			X		X
Proteinuria				X	
Acute renal failure				X	
Blood					
Hemolysis			X		
Methemoglobinemia			X		
Carboxyhemoglobinemia				X	

Table 12: Rapid Reference Tables: Fungicides *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Organomercury compounds	Blood mercury	■ Skin decontamination ■ Chelation with succimer most effective
Copper compounds	No test available	■ Skin decontamination ■ Water or milk as soon as possible ■ Do not induce emesis
Organotin compounds	No test available	■ Skin decontamination ■ GI decontamination if ingestion < ½ hour ■ Chelating agents not effective
Cadmium compounds	Blood and urine cadmium	■ Skin decontamination ■ GI decontamination may be considered ■ Chelation with EDTA may be considered ■ Dimercaprol (BAL) is contraindicated

Table 13: Rapid Reference Tables: Disinfectants

Signs and Symptoms	Glutaraldehyde	Sodium hypochlorite	Cationic detergents	Phenols	Pine Oil
Skin					
Irritation, rash, blistering, erosion		X	X	X	
Nervous system				X	
Respiratory					
Upper respiratory irritation	X				X
Runny nose	X				
Aspiration pneumonia					X
Asthma	X				
Pulmonary edema			X		
Gastrointestinal					
Nausea/vomiting				X	
Diarrhea	X			X	X
Abdominal pain	X				
Blood					
Methemoglobinemia				X	

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Glutaraldehyde	No test available	■ GI decontamination if ingested < 1 hour
Sodium hypochlorite	No test available	■ GI decontamination is contraindicated ■ Dilution with water or milk ■ Do not administer acids due to risk of formation of chlorine gas ■ Eye, skin decontamination
Cationic detergents	No test available	■ Eye, skin decontamination ■ GI decontamination is contraindicated ■ Endoscopy for ingestion of highly concentrated solution or oral burns ■ Use of corticosteroids is controversial
Phenols	No test available	■ GI decontamination is contraindicated ■ Dilution with water or milk
Pine oil	No test available	■ GI decontamination is contraindicated ■ Skin, eye decontamination ■ Observation for at least 6 hours for pulmonary symptoms

Table 14: Rapid Reference Tables: Miscellaneous

Signs and Symptoms	Inorganic arsenicals	Arsine gas	Calcium cyanimide	Creosote	Endothall	Metaldehyde
General						
Hypothermia				X		
Hyperthermia	X					X
Chills		X				
Thirst	X					
Anorexia	X					
Alcohol intolerance			X			
Metallic taste in mouth	X					
Skin						
Irritation, rash, blistering, erosion				X	X	
Contact dermatitis				X		
Pallor				X		
Cyanosis						
Keratoses, brown discoloration	X					
Jaundice	X					
Loss of hair	X					
Brittle nails, white striations	X					
Eye						
Conjunctivitis				X	X	
Nervous system						
Paresthesias	X					
Headache	X			X		
Behavioral-mood disturbances	X					
Depression, stupor, coma, respiratory failure	X					X
Seizures/convulsions	X			X	X	X
Tremor						X
Paralysis	X					
Hypotension, shock	X		X		X	
Cardiovascular						
Cardiac arrythmias	X					
Tachycardia			X			X
Respiratory						
Runny nose	X					
Pulmonary edema				X		
Dyspnea			X	X		
Gastrointestinal						
Nausea/vomiting	X				X	X
Diarrhea	X				X	
Abdominal pain	X					X
Stomatitis	X					
Liver						
Enlargement	X					
Kidney						
Proteinuria	X	X				
Hemoglobinuria		X				
Smoky urine				X		
Blood						
Hemolysis		X				
Methemoglobinemia				X		
Hyperkalemia		X				
Anemia	X	X				
Leukopenia, thrombocytopenia	X					

Table 14: Rapid Reference Tables: Miscellaneous *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Inorganic arsenicals	24-hour urinary arsenic	■ Skin decontamination ■ GI decontamination if ingested < 1 hour ■ Chelation with Dimercaprol (BAL)
Arsine gas	24-hour urinary arsenic	■ Fresh air ■ Intravenous fluids
Calcium cyanimide	No test available	■ Skin decontamination ■ GI decontamination if ingested < 1 hour ■ Hypotension: Trendelenburg, IV fluids ■ Atropine not indicated
Creosote	Dark, smoky urine turns violet/blue with ferric chloride solution	■ Skin, eye decontamination ■ GI decontamination with activated charcoal if patient alert. Should not induce emesis or lavage with pharyngeal redness or swelling ■ Check for methemoglobinemia, BUN, liver function tests, urine for protein, cells and smoky, phenolic excretion products
Endothall	No test available	■ Skin decontamination ■ GI decontamination if ingested < 1 hour and patient is alert ■ Lavage is contraindicated ■ Administer oxygen by mask ■ Monitor blood pressure closely
Metaldehyde	Blood and urine metaldehyde	■ No specific antidote ■ GI decontamination if ingested < 1 hour ■ Seizure control with Diazepam ■ Liver function tests

References

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National Pesticide Information Center, Technical Pesticide Information, http://npic.orst.edu/tech.htm. Includes links to factsheets on toxicology and active ingredients, health information databases, environmental and chemical properties databases; and product, label, and MSDS databases.

Practice Skill V:

Reporting Pesticide Exposure and Supporting Surveillance Efforts

Content

V-1. Understand the importance of surveillance and incident reporting.

- Identify illnesses and hazards that are potentially related to pesticide exposure.
- Review available data that allow for trend analysis of pesticide exposures and health effects.
- Monitor a given population for disease occurrence.
- Identify hypersensitive individuals to develop strategies to prevent disease in others.
- Remove individuals from exposure as indicated.
- Provide information to individuals, groups, and committees about efforts (e.g., reporting and tracking exposures) to further the understanding of pesticide-related advanced health outcomes.
- Be able to access and report data for local, regional, and national surveillance programs.

V-2. Know the roles of selected federal and state agencies with regard to pesticide exposure control.

- The Environmental Protection Agency (EPA) is the lead federal agency for regulation of pesticide use under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). FIFRA requires training and certification of pesticide applicators which is enforced through delegated authority to the states. Health care providers can obtain pesticide information and surveillance data from state agencies and EPA.
- The Federal Food, Drug, and Cosmetic Act (FFDCA) is the basic food and drug law in the U.S. and is administered by the Food and Drug Agency (FDA). It establishes the concept of a tolerance (the maximum legally permissible level of residue at harvest) for pesticide residues in or on human food and animal feed. Tolerances are specific to a pesticide/commodity combination. FFDCA requires EPA to establish these residue tolerances for pesticides in or on food, feed, and byproducts.
- Under the Food Quality Protection Act (FQPA) of 1996, EPA is to review all tolerances for existing pesticides within ten years to determine that they meet the new health-based standard – i.e., that they pose a "reasonable certainty of no harm" from aggregate and cumulative exposures.

(Aggregate exposure refers to exposures from all sources, including residues in food and drinking water, occupational exposures, and incidental exposures. Cumulative exposure refers to exposure to different pesticides that share a common mechanism of action.) FQPA also provides extra protection for infants and children, by requiring an explicit determination that tolerances are safe for children, including an additional safety factor of up to 10-fold, if necessary, to account for uncertainty in data relative to children; and requiring consideration of children's special sensitivity and potential exposure to pesticides.

- Other federal agencies also have important roles in pesticide exposure control, and offer resources for health care providers.
  - The Occupational Safety and Health Administration (OSHA) has authority over work-related exposures (e.g., pesticide manufacturing). OSHA can perform inspections to determine if a hazard is present. Anonymous calls can be made to prompt an investigation. www.osha.gov
  - The National Institute for Occupational Safety and Health (NIOSH) conducts research, funds professional occupational safety and health education, and conducts health hazard evaluations. Providers can obtain educational materials and surveillance data from NIOSH related to occupational safety and health. www.cdc.gov/niosh/homepage.html
  - The Centers for Disease Control and Prevention (CDC) offer epidemiological data and guidance, surveillance, health statistics reports, and laboratory information. www.cdc.gov
  - The Agency for Toxic Substances and Disease Registry (ATSDR) develops case studies in environmental medicine and risk profiles for individual pesticides. atsdr.cdc.gov

- EPA's Worker Protection Standard is the regulation that applies to agricultural pesticide handlers and field workers. It includes requirements for: warnings about pesticide applications, use of personal protection equipment, restrictions on re-entry into treated areas, decontamination, emergency medical assistance, and pesticide safety training.

- State departments of agriculture, health or environment will investigate pesticide exposure incidents. State specific requirements for reporting to Workers' Compensation may vary.

V-3. Report pesticide exposures as required.

- Know the mandatory reporting requirements in the state in which the provider is practicing (over 25 states have mandatory reporting requirements).

- Report pesticide-related illness to the appropriate authorities, such as local and state health departments.

- Be aware of workers' potential reluctance to get involved in reporting of workplace exposures, due to fears of retaliatory action and economic loss. Consent of the patient should be obtained prior to reporting.

- Report and validate Workers' Compensation claims as indicated in each state.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

Resources

EPA Office of Pesticide Programs:
www.epa.gov/pesticides

EPA Worker Protection Standard:
http://ace.orst.edu/info/npic/state1.htmwww.epa.gov/oppfead1/safety/workers/workers.htm

Food Quality Protection Act:
http://npic.orst.edu/fqpa/fqpa.htm

NIOSH:
www.cdc.gov/niosh/homepage.html

State-Based Pesticide Poisoning Surveillance Systems:
www.cdc.gov/niosh/pestsurv/default.html#states

State Pesticide Regulatory Agencies:
http://npic.orst.edu/state1.htm

U.S. Department of Labor, "State Workers Compensation Laws:"
www.dol.gov/esa/regs/statutes/owcp/stwclaw/stwclaw.htm

- Links to online pesticide resources and directories are available through:
  - National Pesticide Information Center (EPA-funded): http://npic.orst.edu
  - EPA's Pesticide Management Resource Guide (PMReG): www.epa.gov/oppfead1/pmreg/index.html
  - NEETF's Pesticides Resource Library: www.neetf.org/Health/Resources/healthcare.htm

Practice Skill VI:

Providing Prevention Guidance and Education to Patients

Content

VI-1. Engage in primary prevention strategies to promote health and prevent disease among patients.

For Individuals and Families:

- Assess perceived risk of exposure. Provide anticipatory guidance about pesticides to prevent exposures. (For example, advise families on appropriate concentrations of DEET.)
- Provide anticipatory guidance about signs, symptoms, and recognition of pesticide exposure; and safe use of pesticides including hygiene practices, and protective clothing (pamphlets, slides, etc.). Advise patients to read and follow label directions on protective garb needed when applying pesticides around the home, garden, or yard. Long pants, a long-sleeved shirt, and chemical-resistant gloves are generally recommended as extra protection even when not required by the label.
- Teach patients to read labels and follow instructions carefully, paying specific attention to precautionary statements and "signal words" that indicate level of toxicity.
- Assess lifestyle factors and medications taken for interactions. Discuss or refer to specialist about use of substitutes.
- Deal appropriately with pesticide-related questions that patients pose – whether by asking additional pertinent questions, by searching out accurate information, by referring patients to specialists, or by preparing oneself to answer certain types of questions (see Examples of FAQs).
- Counsel patients about minimizing unnecessary use of pesticides. Discuss the rationale for integrated pest management. Advise family to contact local county cooperative extension services for information regarding alternatives to pesticide use for control of insects, weeds, etc.
- Discuss potential reproductive toxicity (e.g., teratogenic) effects related to pesticide exposures.
- Caution nursing mothers that pesticides may be excreted into mother's milk.
- Be aware that there may be specific patient populations with limitations in reading labels (illiterate, non-English speaking only, etc.), and special preventive education may be necessary.

Examples of FAQs

- I received a report from my water utility that said the water contains 0.5 ppb of dibromochloropropane. What is this chemical, what does it mean for my health, and what should I do?
- I just read in the newspaper that schools in my state are spraying their buildings with toxic pesticides. I'm worried because my child has asthma and sometimes feels worse at school. Could it be the pesticides?
- I have a six-month-old child and the cat has fleas. Is it safe to have the exterminator in to flea bomb the house? The exterminator says it's safe if we stay out for a few hours and open the windows afterwards.
- My husband and I are having trouble conceiving a child. We own a farm and he sprays pesticides. I want to know if the pesticides may be causing a problem.
- I get a headache and have difficulty concentrating at the office. I think it may be because the janitor sprays pesticides at night.
- I am a farmworker and was picking celery in the fields. Today I have a rash on my hands and arms. Is it from the chemicals?

For Workers:

- Assess occupational exposure risk knowledge.
- Provide anticipatory guidance about pesticides to prevent exposures.
- Educate about signs/symptoms of pesticide exposure.
- Discuss and demonstrate use of personal protective equipment and clothing, (gloves, face shields, aprons, boots). Teach patients to read labels and follow instructions carefully. Discuss the dangers of altering mixing and application procedures. Teach patients to pay attention to specific components of a pesticide label, including precautionary statements and "signal words" that indicate level of toxicity.
- Teach patients to be prepared to treat emergencies prior to occurrence, to know what types of first aid are indicated and contraindicated, and to ensure that necessary equipment, supplies, etc., are available and in proper working order.
- Assess lifestyle factors and medications taken for interactions. Discuss or refer to specialist about use of substitutes.
- Discuss use of closed cab systems in mixing and loading pesticides with proper training, closed tractor cabs in application. Carbon-HEPA filtration systems are recommended in some cases.
- Discuss use of substitute pesticide formulations that are less toxic.

- Discuss need for washing facilities for decontamination and removal of residues before eating or bathroom use.
- Discuss avoidance of mixing/spraying during windy conditions.
- Discuss need to change contaminated clothing at work, place in a separate bag and wash separately from other wash.
- Be aware that there may be specific patient populations with limitations in reading labels (illiterate, non-English speaking only, etc.), and special preventive education may be necessary.

VI-2. Work proactively with patients and the community to prevent exposure, ensure early detection, and limit effects of illness.

Individuals/Families:

- Provide information about emergency procedures to be used if contamination occurs.
- Discuss how to report exposures to appropriate authorities.
- Conduct screening tests to detect pesticide-related exposure/illness (e.g., cholinesterase, spirometry), including baseline screening and after exposure.
- Limit disability and rehabilitate or restore to optimal functioning, for example, by providing avenues for vocational rehabilitation, or case management services to restore optimal functioning.

Workers:

- Conduct worker screening tests (e.g., cholinesterase, spirometry) to detect pesticide-related exposure/illness. If possible, conduct baseline screening before and after exposure. Remove worker from exposure if indicated.
- Advise workers to carry water attached to tractors and know emergency procedures for decontamination (need to follow WPS and OSHA regulations about providing basic hygiene requirements).
- Partner with workers to develop peer support groups for disabled workers.

Population-Based:

- Work with local agricultural extension office, agro-universities, local grain/pesticide sellers, health care practitioners, farm bureaus, garden shops, plant nurseries, manufacturers, distributors, etc. in prevention strategy development.
- Develop network for new work opportunities.
- Work with community groups (e.g., schools, PTA, churches, daycare, migrant groups, farm worker, farm associations, etc.) to identify environmental justice issues, and to discuss and advocate for targeted prevention strategies.

Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

- Discuss need for integrated pest management programs to control pest growth.
- Develop/use pesticide/illness incident reporting system to track patterns of exposure and disease.

Resources

U.S. EPA: Integrated Pest Management, www.epa.gov/oppbppd1/ipm/index.htm.
Read the Label First, www.epa.gov/pesticides/label/ (Explains basic statements found on pesticide product labels.)

National Pesticide Information Center: General Pesticide Information, http://npic.orst.edu/gen.htm#ps. County Extension Offices, http://npic.orst.edu/countyext.htm.

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Extensive resources on pesticides can be found at www.neetf.org/Health/Resources/healthcare.htm

The National Environmental Education & Training Foundation

The National Environmental Education & Training Foundation (NEETF) was chartered by Congress in 1990 as a private non-profit organization that designs and implements innovative programs in life-long environmental learning. NEETF serves students as well as adults, elected and appointed officials of local, state, and federal government, and professionals in health, business, education and the media.

The National Environmental Education & Training Foundation

1707 H Street, NW Suite 900

Washington, DC 20006-3915

Tel: 202-833-2933

Fax: 202-261-6464

E-mail: neetf@neetf.org

Website: www.neetf.org