

# National Pesticide Competency Guidelines for Medical & Nursing Education



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**National Pesticide Practice Competency  
Guidelines For Medical And Nursing  
Practice**

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

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# Reviewers

This document has been reviewed in draft form by individuals chosen for their unique perspectives and technical expertise. The purpose of this independent review was to elicit candid and critical comments that would assist in making this published document as sound and effective as possible. We thank the following individuals for their review of this document:

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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.

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# Foreword

Pesticide poisoning in the United States remains under-recognized and under-treated. The lack of attention to pesticide poisoning exists in spite of 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.

These guidelines outline the knowledge and skills that students in the health professions need to have about pesticides. We recognize the challenge that health educational institutions face in terms of incorporating additional content. Nevertheless, it is important to find room for pesticide concerns – both in terms of the very real health threats that they pose, and as a first step in addressing the growing problem of environmental toxins. Medical and nursing schools – and individual faculty members – will of course wish to make their own choices about how and where to incorporate this information in their courses. We hope these guidelines help in that task.

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# 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 focuses on the knowledge base that should be mastered by students as part of medical or nursing training. The companion document defines the skills and knowledge base that should be mastered and demonstrated by primary care physicians and nurses in the practice arena. The authors of both documents collaborated to ensure consistency across both documents.

The two documents were developed specifically for everyday, frontline health care professionals, rather than for specialists and researchers. The Educational Competency guidelines are aimed at basic and advanced components of educational institutions, rather than specialties such as occupational and environmental medicine. Similarly, the Practice Skills guidelines are aimed at primary care providers, rather than medical toxicologists or specialists in occupational or environmental medicine.

As faculty and administrators in medical and nursing schools decide how to incorporate pesticide-related information, it is hoped that these national guidelines and the larger initiative on pesticides and health care providers will serve as a model for integrating other environmental health issues into health care provider education and training.

## 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.

The *National Strategies for Health Care Providers: Pesticides Initiative* (<http://www.neetf.org/Health/providers/index.shtml>) 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). It 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.

## Incorporation into the Curriculum

Although some progress has been made in introducing environmental health issues into the curriculum of medical and nursing schools, more remains to be done. And yet, it is hard to find space in the already crowded curricula of medical and nursing schools for new topics and subject areas. To facilitate integration, this document notes possible "Points of Insertion" for each competency. We strongly recommend that pesticide content be integrated into *existing* adult health, pediatric, research, ethical/legal units of instruction and community health nursing courses, both didactic and clinical. This can be done, for example, by using pesticides to enhance existing case studies, or as exemplars.

The changing worlds of medical and nursing education present a challenge in identifying where in the curriculum a particular pesticide topic would be most appropriate. Curricula are highly variable in the form and substance of topics. Some schools of nursing and particularly some schools of medicine have adopted Problem Based Learning or other case-based methods or organ system approaches to all or most of their curricula. Many schools continue to use a traditional curriculum and maintain a traditional governance structure based on departmental control of curriculum structure. A topic such as pesticides may be adapted by faculties with either style of curriculum, but the vehicle used may require modification of the teaching method and style.

In suggesting points of insertion into the curriculum, we have included such components as environmental or preventive medicine electives, public sector medicine courses, etc. These serve only as examples; many schools will have other courses or departments that the material could fit into equally well. Schools that do not have such courses in place are certainly encouraged to consider adding them.

The competencies proposed in this document recommend integration of content into medical and nursing curricula at all levels. Competency I, Knowledge and Concepts of Pesticides, is considered the most important and basic level that should be incorporated into *all* curricula as a top priority. Content items marked with an asterisk (\*) are considered appropriate for the more advanced health care student (i.e., residents or nurse practitioner students), in addition to the other content items.

The role of faculty development in advancing a pesticide-related curriculum cannot be over-emphasized. If one or more faculty members are identified as having a special interest or ability in Environmental Health/ Toxicology, those members may serve as a resource for other faculty members, especially when the small group clinical case scenario method is used.

The next section of this document contains a brief "primer" on pesticides, with background material on pesticide regulation, uses, exposures, and absorption. The remainder of the document outlines the five educational competencies – the information content, suggested points of insertion, and a sampling of relevant resources. Readers are encouraged to consult the extensive resources available on the Internet. Useful starting points include: the National Pesticide Information Center (<http://npic.orst.edu>), and NEETF's Online Pesticide Resources Library ([www.neetf.org/Health/Resources/healthcare.htm](http://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 bio-concentrate 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.

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.

About three-fourths of U.S. households use pesticides (Aspelin and Grube, 1999). Few homeowners who use pesticides themselves have received any training. Because products can be purchased at grocery stores, hardware stores, and pharmacies, consumers may assume that the products they use themselves 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 typically have the least specialized application equipment, but they usually apply 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 pesti-

cide 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, 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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# Pesticide Competency Guidelines for Medical and Nursing Education

## *Content, Insertion Points, and Resources for Educational Curricula*

The Pesticide Education Competencies outlined in this document are intended to apply to medical and nursing schools as guidelines in training students to recognize, manage, and prevent pesticide-related illness. The guidelines laid out below are intended as an accompaniment to the *Recognition and Management of Pesticide Poisonings* (U.S. EPA, 1999) handbook for health professionals.

The five competencies (see list on next page) were developed as part of the Draft Implementation Plan (NEETF, 2000) of the *National Strategies for Health Care Providers: Pesticides Initiative*. An initial start at defining competencies was carried out by a subgroup of the Education Workgroup in May 1999, and was further elaborated in July 1999 by a small committee. This set of five competencies was accepted by the full Education Workgroup. They are derived from a combination of recommendations from the Institute of Medicine for incorporating environmental health into medicine and nursing curricula. Competency I, Knowledge and Concepts of Pesticides, is considered the most important and basic level that should be incorporated into all curricula as a top priority.

For each competency area, we specify the content of the information to be learned, identify points in the curriculum where this information might be inserted, and suggest resources to consult. An asterisk (\*) denotes material for residents and nurse practitioner students over and above that of the undergraduate.

We strongly recommend that pesticide content be integrated into *existing* adult health, pediatric, research, ethical/legal units of instruction and community health nursing courses, both didactic and clinical. This can be done, for example, by using pesticides to enhance existing case studies, or as exemplars. In suggesting points of insertion into the curriculum, we have included such components as environmental or preventive medicine electives, public sector medicine courses, etc. These serve only as examples; many schools will have other courses or departments that the material could fit into equally well, such as Problem-Based Learning.

A more complete resource library with links to sources of information is available online at <http://www.neetf.org/Health/Resources/healthcare.htm>.

## Five Educational Competencies

### Competency I: Knowledge and Concepts of Pesticides

#### I-1. Principles of Environmental and Occupational Health Related to Pesticides

- a. Understand the basics of environmental and occupational health
- b. Understand the broad spectrum of chemicals classified as pesticides and their areas of use
- c. Understand mechanisms and pathways of exposure
- d. \*Understand temporal relationship between exposure and symptom
- e. \*Understand advanced toxicology, specifically related to organophosphates, carbamates, and pyrethroids

#### I-2. Individual Patient Knowledge and Skills

- a. Relate the environment in which the patient (and family) lives, works, and plays to potential hazards and exposures
- b. Identify risk factors for occupational pesticide exposures
- c. Identify risk factors for pesticide exposures at home
- d. Recognize that other family members may be ill from pesticide exposure in addition to index patient
- e. Understand potential moral, ethical, and legal implications for patients of reporting and referral

#### I-3. Population-Based Health Knowledge and Skills

- a. Understand the concept of population-based health as it pertains to pesticide exposure
- b. Recognize socioeconomic impacts of pesticide-related illness
- c. Understand potential moral, ethical, and legal implications for the community of reporting and referral
- d. Possess a basic awareness of the role of prevention, and general awareness of benefits of alternatives to conventional pest control.

### Competency II: Diagnosis and Assessment

#### II-1. Environmental History: Be able to take an environmental history

#### II-2. Differential Diagnosis: Be able to consider pesticides in a differential diagnosis of poisoning and be aware that signs and symptoms of pesticide over-exposure may be non-specific

#### II-3. Signs and Symptoms: Recognize signs and symptoms of pesticide over-exposure, especially widely used cholinesterase-inhibitors and pyrethroids insecticides

\* An asterisk denotes material for residents and nurse practitioner students over and above that of the undergraduate.

### **Competency III: Treatment, Intervention, and Referrals**

- III-1. Treatment: Be able to effectively treat health conditions related to pesticide over-exposures
- III-2. Intervention: Be able to advise health care providers on decontaminating patients and the environment following over-exposure
- III-3. Referrals: Understand when to make referrals to appropriate occupational / environmental health specialists
- IV-4. Follow-Up: Be able to arrange appropriate patient follow-up

### **Competency IV: Risk Communication**

- IV-1. Patient Education: Be able to educate patients about basic routes of exposure and absorption, and how to minimize exposure to pesticides
- IV-2. Labels: Be able to advise patients on how to read pesticide labels

### **Competency V: Reporting Requirements and Regulations**

- V-1. Surveillance Needs: Understand the importance of surveillance and incident reporting
- V-2. Reporting: Know how to participate in mandatory state surveillance systems and reporting requirements
- V-3. Regulations: Understand other legal and regulatory provisions that have implications for health care providers
- V-4. \*Legal Framework: Understand framework of federal laws that address pesticides and pesticide exposures
- V-5. Ethical, Legal, Advocacy: Understand ethical, legal, and advocacy roles of health care providers in pesticide exposure incidents

\* An asterisk denotes material for residents and nurse practitioner students over and above that of the undergraduate.

# Competency I:

## Knowledge and Concepts of Pesticides

### I-1. Principles of Environmental and Occupational Health Related to Pesticides.

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#### I-1a. Understand basics of environmental and occupational health.

##### Content

- The student should know the primary environmental health effects that patients encounter today, including issues in their local community as well as national and international environmental health problems.
- Know likely household exposures.
- Know the primary issues that are unique to children, vulnerable populations at disproportionate risk, and the elderly.
- Know the primary occupational health hazards that workers face. Know how to take an Occupational and Environmental Medicine (OEM) history.

##### Points of Insertion

##### ■ Nursing

- ▶ Community Health or Public Health Nursing courses, both didactic courses and clinical rotations
- ▶ Home Health Nursing courses (didactic and clinical)
- ▶ Adult Health Nursing or Occupational Health Nursing courses
- ▶ Units of instruction on health promotion, protection and prevention of illness and injury
- ▶ Units of instruction on current trends and issues in nursing practice

##### ■ Medicine

- ▶ 3rd year medical school clerkship in Pediatrics, Family Medicine, and Internal Medicine may all have components for such clinical and epidemiological information
- ▶ A 4th year elective in the medical school curriculum on Environmental Health, Preventive Health, Epidemiology, or similar subject may be considered or already exist in a school's curriculum

## I-1b. Understand the broad spectrum of chemicals classified as pesticides and their areas of use.

### Content

The student should be aware of various types of pesticides, especially the following categories and selected agents within each category. Students should be aware that brand names for pesticide products change from year to year, therefore the focus should be on active ingredients.

#### ■ Insecticides

- ▶ Agents that inhibit cholinesterase: organophosphates and n-methyl carbamates
- ▶ Pyrethrins (ocloresin extract of chrysanthemum) and pyrethroids (the synthetic derivative of natural pyrethrins. A clinically recognizable example of a pyrethroid is permethrin (Nix®, Elimite®); however, there are many other brand names of permethrin, and many other pyrethroids.
- ▶ Organochlorines
- ▶ DEET
- ▶ Boric Acid
- ▶ Fluorides
- ▶ Nicotine (There were still reports of toxicity in the 1990s from old stores of nicotine.)
- ▶ Arsenicals (Rarely used anymore, with the exception of some ant bait stations.)

#### ■ Herbicides

- ▶ Chlorophenoxy herbicides (2-4D, mecoprop are both widely available)
- ▶ Paraquat and diquat
- ▶ Pentachlorophenol and dinitrocresol (wood preservatives)
- ▶ Copper chromium arsenate (Primary source of wood preservative for decks, fences, and children's wood playground sets – discontinued in 2003.)

#### ■ Fumigants

- ▶ Include: cyanide, 1, 3-dichloropropane, metam-sodium, methylbromide, naphthalene, phosphine gas (from aluminum phosphide)
- ▶ Accidental dermal exposure and inhalation, especially after premature re-entry, can cause severe toxicity. Most fatalities are due to suicidal ingestion, because of the high concentration of exposure.

#### ■ Rodenticides

- ▶ Warfarin-related compounds: warfarin, coumarins, brodifacoum, difenacoum (so-called "super warfarins")
- ▶ Others: thallium, zinc phosphide, sodium fluoroacetate

#### ■ Fungicides

- ▶ Include: hexachlorobenzene, thiram, maneb, methylmercury compounds

## ■ Disinfectants

- ▶ Agents used for sanitization and sterilization in the home and hospital
- ▶ Registered as pesticides by the U.S. EPA
- ▶ Examples include alcohols, chlorhexidine, hypochlorites, iodines, phenols, and pine oil.

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## I-1c. Understand mechanisms and pathways of exposure.

### Content

#### ■ Know the most common patterns of exposure:

- ▶ Unintentional (common exposure pattern in children)
  - ▶ For acute poisoning, pathway is generally intestinal absorption from unintentional ingestion.
  - ▶ Inhalation exposure and dermal from surrounding environment
  - ▶ Hand to mouth activity in children
- ▶ Occupational
  - ▶ Inhalation is a common pathway.
  - ▶ Dermal exposure is important, especially for pesticide applications.
  - ▶ Ingestion is less common in the occupational setting, but can occur through failure to wear protective gloves and following poor hygiene practices.
- ▶ Intentional (suicide attempt/intentional abuse)
  - ▶ Ingestion is primary pathway.
  - ▶ Inhalation is another pathway, although primary agents of abuse in this manner are non-pesticide chemicals (aromatic solvents).

#### ■ Know the biochemical mechanism of action for organophosphates/ carbamates.

- ▶ Understand that there are many different pesticides with different methods of action.
- ▶ Organophosphates and carbamates:
  - ▶ Mechanism of action: Inhibition of the enzyme acetylcholinesterase (AChase)
  - ▶ This is accomplished by the binding of the pesticide to the AChase, forming either a carbamyl-AChase complex or a phosphoryl-AChase complex.
  - ▶ Result is an accumulation of ACH at synapse site, causing unopposed cholinergic stimulation.
- ▶ Know that pyrethroids may sometimes present with similar clinical findings as cholinesterase inhibitors, but the method of action is entirely different.



**\*1-1d. Understand temporal relationship between exposure and symptom.****Content**

- Know that onset of symptoms of acute poisoning will occur shortly (within 24-48 hours) after exposure.
- Know that some chronic symptoms may follow an acute exposure, such as organophosphate-induced delayed neuropathy with onset a few weeks after exposure.
- Know that in cases of continued but lower level exposure (chronic or subacute exposure), symptoms may present much later. Examples include possible links to cancer following long-term pesticide exposure.

**\*1-1e. Understand advanced toxicology, specifically related to organophosphates, carbamates, and pyrethroids.****Content**

- Know that cholinesterase inhibition is readily and spontaneously reversible with carbamate poisoning. Poisoning due to carbamates therefore does not require the use of pralidoxime. However, cholinesterase inhibition due to organophosphate poisoning is less reversible. The enzyme can be reactivated by pralidoxime, especially in the first 48 hours following organophosphate poisoning.
- Know that pyrethroids are rapidly metabolized in the mammalian liver, accounting for their relatively lower toxicity than organophosphates.
- Know that cyano-pyrethroids are more toxic than other pyrethroids.

**Points of Insertion for 1-1 (b-e)**

- Undergraduate Nursing
  - ▶ Pathophysiology course unit
  - ▶ Pharmacology course unit
  - ▶ Community Health or Public Health Nursing courses (didactic and clinical)
- Advanced Practice Nursing
  - ▶ Environmental Health or Occupational Health program course, including a course in Toxicology and applied in Environmental or Occupational Health Nursing didactic and clinical courses
- Undergraduate Medicine
  - ▶ Pharmacology class in 2nd year
  - ▶ Clinical rotations tailored to specific patient encounters during 3rd year
  - ▶ ER rotation in 4th year

■ Residency

- ▶ Elective in Toxicology or Environmental Medicine, ER rotation, clinical patient case discussions

**Resources for Competency I-1 (a-e)**

■ Online Resources:

- ▶ State and Regional Poison Control Centers: <http://npic.orst.edu/poison.htm>
- ▶ National Pesticide Information Center (EPA-funded): <http://npic.orst.edu>
- ▶ EPA's Pesticide Management Resource Guide (PMReG):  
[www.epa.gov/oppead1/pmreg/index.html](http://www.epa.gov/oppead1/pmreg/index.html)
- ▶ NEETF's Pesticides Resource Library: [www.neetf.org/Health/Resources/healthcare.htm](http://www.neetf.org/Health/Resources/healthcare.htm)

■ Publications:

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\* An asterisk denotes material for residents and nurse practitioner students over and above that of the undergraduate.

## **I-2. Individual Patient Knowledge and Skills.**

### **I-2a. Relate the environment in which the patient (and family) lives, works, and plays to potential hazards and exposures.**

#### **Content**

- The student should know about the common pesticide hazards associated with major rural and urban industries, occupations, and avocations, including commercial agriculture, farming, grounds keeping, plant nursery maintenance, general lawn care, structural pest control / exterminators, parks, playgrounds, home or apartment yards, in-house treatments for pests (e.g., ants, roaches), home and gardens, schools and day care centers.
- Numerous pesticides are used for public health protection, including water purification, sewage treatment, vector control.
- Be aware that the vast majority (80-90%) of pesticides produced are used for commercial agriculture; the remainder are used for structural pest control, horticulture, and consumer home and garden purposes.
- Be aware that health care professionals typically use and are exposed to a large number of registered pesticides on a regular basis.
- Understand that children are at risk for greater pesticide exposure from residuals in food than are adults due to greater consumption per kilogram of body weight, and that prevention of this excess exposure is addressed by the Food Quality Protection Act of 1996.

#### **Points of Insertion**

- Community Health and Public Health Nursing courses (didactic and clinical)
- Public Sector Medicine rotation
- 4th year medical school elective in Environmental or Preventive Medicine

### **I-2b. Identify risk factors for occupational pesticide exposures.**

#### **Content**

- Understand that commercial preparations of pesticides may be more concentrated, and therefore pose greater risk to someone in an occupational setting (particularly manufacturing) than the use of a diluted final product.
- Understand that highest risk of exposure is faced by individuals working in agricultural pest control operations: mixing, loading, applying, and flagging. Mixers and loaders are exposed to concentrated pesticides and large volumes.

- Understand strategies for reducing the risk of exposure, including engineering controls, such as closed systems for loading pesticides into tanks, and correct use of personal protective clothing and devices.
- Know that pesticide handlers and workers on farms, forests, greenhouses, and nurseries are required to be supplied with appropriate protective gear by their employers.
- Understand that pregnant women who work with pesticides are at high risk and should consider switching to other tasks, if possible, at least during the first trimester of pregnancy, or should maximize their use of personal protective clothing.
- Understand that workers are at risk of exposure if insufficient time is allowed before re-entry to treated fields.
- Understand need for proper removal and handling of contaminated clothing and showering prior to going home to reduce risk of exposure to residuals on clothing and skin.

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### **I-2c. Identify risk factors for pesticide exposures at home.**

#### **Content**

- Understand that women, especially those who are pregnant, and children of farming families are vulnerable to pesticide exposure even if they don't work in the fields. Migrant workers and their families may also suffer from poor living conditions, lack of command of the English language, and sporadic medical care.
- Know that homes located near farmlands may constitute a particular hazard (above the baseline risks of personal pesticide application to yards).
- Know that children family members on farms are at risk for exposure to concentrated agents and old supplies of chemicals that are no longer used. Children playing in or near the fields while their parents work are at risk for exposure to pesticides.
- Emphasize to families that care should be taken to reduce exposure to pesticides in areas where food is prepared and consumed, and in children's play areas.
- Be aware that pesticides used by consumers for home and garden are often nearly identical in formulation as those used by professional applicators or differ only in reduced strength of active ingredient.
- Be aware that pesticide residues are implicated in chemical sensitivities reported by patients who may experience symptoms in multiple systems in response to exposures to chemicals and environmental agents widely tolerated by a majority of people.
- Know that children incur more risk than adults due to the immature nature of their immune system, larger surface area to body weight ratio, higher metabolic rate, different diet patterns and activities, different exposure profiles, and hormonal changes at puberty.

- Be aware that children are more apt to have extended contact with ground level surfaces and may have extended contact with pets. Properly applied spot treatments, directed or crack and crevice sprays, baits, gels, and pastes pose less potential for exposure than broadcast treatments.
- Know that contamination of food, clothing, and other objects can occur through improper application of pesticides in homes, or if items are not removed or covered prior to treatment of the area.
- Know that improper practices, including use of food or drink containers to store pesticides, reuse of empty pesticide containers, and failure to lock pesticides away from children, have resulted in serious illnesses and injuries to children.
- Recognize that consumers generally have less education and training on how to properly apply pesticides than farmers or commercial applicators.
- Be aware that residues may be carried into homes on shoes worn across treated surfaces (lawns) or on clothing worn to apply pesticides.

#### Points of Insertion

- Nursing

- ▶ Community Health Nursing and Primary Care rotations
- ▶ Maternal / Child Health Nursing
- ▶ Medical / Surgical Nursing
- ▶ Psychiatric / Mental Health Nursing rotation
- ▶ Unit on Oncology

- Medicine

- ▶ Public Sector Medicine rotation
- ▶ Primary Care rotations
- ▶ Psychiatric / Mental Health rotation
- ▶ Oncology rotation
- ▶ 4th year elective in Environmental or Preventive Medicine

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#### I-2d. Recognize that other family members may be ill from pesticide exposure in addition to index patient.

##### Content

- Understand that family members, including women and children, of exposed individuals are at risk for exposure to reproductive and childhood toxicants due to residues "brought home" on clothing, shoes, etc.
- Understand the epidemiological concept of "disease clustering" and that a single exposure may result in numerous family / household members being sick.

- Understand risks of perinatal exposure and implications for pregnancy outcomes, fetal effects, lactation, and child development / developmental disabilities, elderly, individuals with chemical sensitivities, and other vulnerable populations.
- Understand risks of consuming foods that contain residues of pesticides while working / harvesting agricultural products.

#### Points of Insertion

- Nursing
  - ▶ Community Health or Public Health Nursing rotations
  - ▶ Maternal / Child Health units of instruction
  - ▶ Psychiatric / Mental Health units of instruction
- Medicine
  - ▶ Public Sector Medicine rotations
  - ▶ Pediatric and Obstetrical rotations
  - ▶ 4th year elective in Environmental or Preventive Medicine

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### **I-2e. Understand potential moral, ethical, and legal implications for *patients* of reporting and referral.**

#### Content

- Know state-specific reporting requirements for the workers' compensation system or surveillance system. Be able to list which states have mandatory pesticide case reporting and the process for reporting.
- Understand that health care providers are often the first to identify a sentinel health event. Understand the need to recognize such an event and the process for reporting.
- Understand workers' reluctance to get involved in pesticide case reporting, ranging from fear of retaliatory actions such as loss of job or pay cuts, to fear of complete closure of an operation with the loss of many jobs. Therefore, consent of the patient should be obtained prior to reporting.
- Understand that pesticide contamination at sites such as schools, daycare centers, and businesses have additional consequences beyond individual health effects. Such legal and financial issues may affect willingness to report and disclose.
- Be able to describe the health care provider's role in assuring follow-up of patients with pesticide exposure, in order to reduce the risk of re-exposure or return to work sites where re-exposure is likely.
- Learn how to access state data on pesticide use and pesticide poisonings, where available.

## Points of Insertion

### ■ Nursing

- ▶ Community Health or Public Health Nursing rotation
- ▶ Units of instruction on ethical/legal issues in nursing; patient advocacy role of the nurse
- ▶ Advanced Nursing Practice courses (e.g., graduate midwifery, FNP, PNP) addressing ethical, legal, public policy issues in health care and role of nursing

### ■ Medicine

- ▶ Ethical, legal issues of medical practice
- ▶ Public Sector Medicine rotation
- ▶ 4th year elective in Environmental or Preventive Medicine
- ▶ Occupational Medicine

## Resources for Competency I-2:

### ■ Code of Ethics for specific disciplines

### ■ Websites:

- ▶ Occupational Safety and Health Administration (OSHA): [www.osha.gov](http://www.osha.gov)
- ▶ National Pesticide Information Center, Technical Pesticide Information: <http://npic.orst.edu/tech.htm>

### ■ Pesticide Information Databases:

- ▶ Extension Toxicology Network (EXTOXNET): <http://ace.ace.orst.edu/info/extoxnet>
- ▶ Crop Data Management Systems (CDMS) database: [www.CDMS.net/pfa/LUpdateMsg.asp](http://www.CDMS.net/pfa/LUpdateMsg.asp)
- ▶ Integrated Risk Information System (IRIS): [www.epa.gov/ngispgm3/iris](http://www.epa.gov/ngispgm3/iris)  
An electronic database, maintained by EPA, on human effects that may result from exposure to various chemicals in the environment. Provides hazard assessment and dose-response assessment information.

### ■ Publications:

- ▶ ATSDR Case Studies in Environmental Medicine, Agency for Toxic Substances and Disease Registry, [www.atsdr.cdc.gov/HEC/CSEM](http://www.atsdr.cdc.gov/HEC/CSEM)
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in Practice, Institute of Medicine. *Nursing, Health, and the Environment: Strengthening the Relationship to Improve the Public's Health*. Washington, DC: National Academy Press; 1995; p. 45, Box 3.1.

- ▶ Reigart JR, Roberts JR. *Recognition and Management of Pesticide Poisonings*, 5th ed. Washington, DC: U.S. Environmental Protection Agency; 1999. EPA#735-R-98-003.
- ▶ Rosenstock L, Cullen M. *Textbook of Clinical Occupational and Environmental Medicine*, Chapter 1. Philadelphia, PA: W.B. Saunders Company; 1994.

### **I-3. Population-Based Health Knowledge and Skills.**

#### **I-3a. Understand the concept of population-based health as it pertains to pesticide exposure.**

##### **Content**

- Understand the key components of the Food Quality Protection Act of 1996 and how it pertains to prevention of excessive pesticide exposure to children:
  - ▶ Establishes a single, health-based standard for all pesticide residues in food.
  - ▶ Requires a re-evaluation of all tolerances (maximum amount of pesticide allowed on food) by August 2006.
  - ▶ Requires that EPA use an additional 10-fold safety margin when setting standards for pesticides on foods to protect children, and allows EPA to use a different margin of safety only if, on the basis of reliable data, such a margin will be safe for children.
  - ▶ Requires that EPA ensure that there is a reasonable certainty that no harm will result to infants and children from aggregate exposure to the pesticide residue (including from other sources such as water, residential, etc.).
  - ▶ Requires that EPA consider the cumulative effects from all pesticides that share a common mechanism of action.
  - ▶ Provides certain right-to-know provisions for consumers.
- Understand the context of community population-based health. Know that the populations of entire neighborhoods and regions can be affected by pesticide contamination of the environment.
- Understand that issues of public health must be approached from a population-based primary, secondary, and tertiary prevention perspective.
- Understand the use of epidemiologic data to support presumed causal relationships between an exposure and an outcome.

##### **Points of Insertion**

- Nursing
  - ▶ Community Health or Public Health Nursing courses (didactic and clinical)
  - ▶ Advanced Nursing Practice courses addressing ethical, legal, or public policy issues



■ **Medicine**

- ▶ Public Sector Medicine rotation or Evidence-Based Medicine
- ▶ 2nd year Introduction to Clinical Medicine
- ▶ 4th year elective in Environmental or Preventive Medicine

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**I-3b. Recognize socioeconomic impacts of pesticide-related illness.**

**Content**

- Be aware of socioeconomic implications of pesticide-related illness on each of the following groups:
  - ▶ Individual / family (e.g., impact on a head-of-household earning minimum wage)
  - ▶ Employers and related businesses (e.g., loss of business, employees, customers)
  - ▶ Community (e.g., well water contamination, drinking water supplies)
  - ▶ Society (e.g., contamination of underground water reserves, lakes, waterways)
- Understand potential economic impacts on workers who cannot return to jobs, temporarily or permanently, due to pesticide exposure and poisoning. Give at least three specific examples: migrant farmworker, mixer/loader, and applicator.
- Understand the role of advocacy and justice in environmental and occupational health, and workers' compensation.

**Points of Insertion**

■ **Nursing**

- ▶ Community Health or Public Health Nursing courses
- ▶ Units of instruction on ethical, legal aspects of nursing
- ▶ Units of instruction on health policy and client advocacy in nursing

■ **Medicine**

- ▶ Public Sector Medicine rotation
- ▶ 4th year elective in Environmental or Preventive Medicine
- ▶ Ethical, legal, advocacy issues of medical practice

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**I-3c. Understand potential moral, ethical and legal implications for the community of reporting and referral.**

**Content**

- Understand barriers and challenges to providing optimal care to migrant farmworkers, other transient populations, and individuals without U.S. citizenship, green cards, work permits, etc., since they are often the most vulnerable populations for exposure.
- Understand how economic, workplace issues sometimes outweigh health issues for vulnerable populations.

- Know that health care providers are obligated to report pesticide-related illness in some states.
- Be able to describe Healthy People 2010: National Health Promotion and Disease Prevention Objective 10 relative to reducing the morbidity and mortality of the population due to toxic exposures.

#### Points of Insertion

- Nursing
  - ▶ Community Health or Public Health Nursing courses (didactic and clinical)
  - ▶ Ethical, legal aspects of nursing / medicine
  - ▶ Health policy courses at both undergraduate and graduate levels
- Medicine
  - ▶ Public Sector Medicine rotation
  - ▶ 4th year elective in Environmental or Preventive Medicine

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### I-3d. Possess a basic awareness of the role of prevention and benefits of alternatives to conventional pest control.

#### Content

- Be able to provide appropriate anticipatory guidance to individuals and families regarding appropriate use of pesticides and products. (For example, be able to advise family on appropriate concentrations of DEET.)
- Know to advise family to contact local county Cooperative Extension services (check local telephone directory blue pages under county Cooperative Extension) or National Pesticide Information Center (<http://npic.orst.edu>) for information regarding integrated pest management (IPM) and alternatives to pesticide use for control of insects, weeds, etc.
- Be able to describe the goals of Healthy People 2010 relative to the health promotion, health education, and prevention of illness relative to pesticide exposure.
- Be able to teach individuals and families to read labels and follow directions when using products containing pesticides.

#### Points of Insertion

- Nursing
  - ▶ Ethical, legal aspects of nursing at both undergraduate and graduate levels
  - ▶ Role courses at both undergraduate and graduate levels
  - ▶ Community Health or Public Health Nursing courses (didactic and clinical)

## ■ Medicine

- ▶ Ethical, legal aspects of medicine at both undergraduate and graduate levels
- ▶ Public Sector Medicine
- ▶ 4th year elective in Environmental or Preventive Medicine
- ▶ Occupational Medicine
- ▶ Agromedicine if available in curriculum

## Resources for Competency 1-3:

### ■ Online:

- ▶ U.S. EPA: Integrated Pest Management: [www.epa.gov/oppbppd1/ipm/index.htm](http://www.epa.gov/oppbppd1/ipm/index.htm). Read the Label First, [www.epa.gov/pesticides/label/](http://www.epa.gov/pesticides/label/) ("Interactive label" shows pop-up text that explains the basic statements found on pesticide product labels.)
- ▶ National Pesticide Information Center, General Pesticide Information: <http://npic.orst.edu/gen.htm#ps>.

### ■ Publications:

- ▶ Department of Health and Human Services. *Healthy People 2010: National Health Promotion and Disease Prevention*. Washington, DC: Dept. of Health and Human Services; 2000.
- ▶ Hennekens CH, Buring JE. Chapter 3: Statistical association and cause and effect relationships. In: Mayrent SL, ed. *Epidemiology in Medicine*. Boston, MA: Little, Brown and Company; 1987:30-41.
- ▶ Hitchcock J, Schubert P, Thomas S. *Community Health Nursing*. Albany, NY: Delmar Publishers; 1999:15-16.
- ▶ Institute of Medicine. *Role of the Primary Care Physician in Occupational and Environmental Medicine*. IOM Report, Division of Health Promotion and Disease Prevention, Washington, DC: National Academy Press; 1988.
- ▶ Pope AM, Snyder M, Mood L, for Committee on Enhancing Environmental Health Content in Practice, Institute of Medicine. *Nursing, Health, and the Environment: Strengthening the Relationship to Improve the Public's Health*. Washington, DC: National Academy Press; 1995; 17-8.
- ▶ Rogers B. *Occupational Health Nursing Concepts and Practice*. Chapter 1, 2, 5. Philadelphia, PA: W.B. Saunders Company; 1994.
- ▶ Rosenstock L, Cullen M. *Textbook of Clinical Occupational and Environmental Medicine*, Chapters 1-2. Philadelphia, PA: W.B. Saunders Company; 1994.
- ▶ Reigart JR, Roberts JR. *Recognition and Management of Pesticide Poisonings*, 5th ed. Washington, DC: U.S. Environmental Protection Agency; 1999. EPA#735-R-98-003.
- ▶ U.S. Environmental Protection Agency. *The Worker Protection Standard for Agricultural Pesticides*. Washington, DC: U.S. EPA; 1994.

# Competency II:

## Diagnosis and Assessment

### II-1. Environmental History: Be able to take an environmental history.

When considering taking an environmental history related to pesticide exposure, it is useful to compare it to the chances of finding relatively uncommon diseases in a lifetime of general practice. Although one may obtain thousands of complete blood counts to find one case of childhood leukemia, we are taught to include such illnesses in a differential diagnosis. If we don't consider the uncommon illness in the diagnosis, one day it might be missed. Similarly, if pesticide poisoning is not considered in a patient's differential diagnosis, it will surely be missed.

#### Content

- Know sources of additional information relevant to a patient history:
  - ▶ Pesticide labels: [www.CDMS.net/pfa/LUUpdateMsg.asp](http://www.CDMS.net/pfa/LUUpdateMsg.asp)
  - ▶ Material safety data sheets (MSDS): For a list of sites with MSDS information, go to: [www.phys.ksu.edu/area/jrm/Safety/msds.html](http://www.phys.ksu.edu/area/jrm/Safety/msds.html)
  - ▶ Agency for Toxic Substances Disease Registry (ATSDR) ([www.atsdr.cdc.gov](http://www.atsdr.cdc.gov))
  - ▶ Pesticide manufacturer: Contact information should be on the label, or go to: <http://npic.orst.edu/manuf.htm>
- Be able to complete a detailed environmental history for the **adult patient** when indicated, to include the following elements:
  - ▶ Occupation, including length of time on job, nature of work, involvement with hazardous materials, use of protective equipment, habits at worksite (eating, smoking), and prior jobs
  - ▶ Home environment, including presence of or use of pesticides in house, lawn, garden; use on pets; storage of pesticides; location of home in relation to industries, dump sites, farms
  - ▶ Source of drinking water
  - ▶ Food sources
  - ▶ Relocation of home due to health problems
  - ▶ Source of heat in home (e.g., wood stove)
  - ▶ New/recent construction or new materials (e.g., carpets)
  - ▶ Medical condition and symptoms, including temporal relationship to any given place or time, others with similar problems (co-worker or family member)
  - ▶ Use of tobacco, alcohol, other drugs (illegal, prescription, and over-the-counter), constant exposure to second-hand smoke
  - ▶ Recreational activities and hobbies of the patient or family
- Be able to complete a detailed environmental history for the **pediatric patient**, to include the following elements. (Under most circumstances, similar items in the adult history should be covered, from the child's perspective.)

- ▶ Occupation / hobbies of parents and other guardians or individuals living in the home to a level of detail similar to above. If the child spends time with a sitter or another person's home, inquire about occupations, hobbies, etc., in those homes as well.
  - ▶ Use of pesticides in home/play areas; child's play activities in relation to areas treated; protection of toys and surfaces during pesticide application
  - ▶ Proper washing of food (eggs, raw fruits, vegetables)
  - ▶ For infants: if bottle-fed, inquire into source of water for formula; if breast-fed, consider maternal exposures
  - ▶ Proper storage of dangerous chemicals (i.e., is home properly "child proofed")
  - ▶ Amount of food consumed by child, and relationship between amount of exposure / body weight for child compared to that of an adult
  - ▶ Be able to do developmental history (e.g., infants crawling on the floor, walking, getting into objects)
  - ▶ Pesticide use on pets
- \*Know specific questions for **agricultural workers** and their families:
  - ▶ Is there spraying going on while you are in the field?
  - ▶ Do you feel sick while in the fields?
  - ▶ Were the fields wet when you were picking? (Note: Dry fields can be a source of residues and are potentially hazardous with certain crops such as citrus, grapes.)
  - ▶ Do your children play in the fields?
  - ▶ Do you have lunch in the fields?
- \*Be able to complete a brief screening environmental history: (This is reserved for residents, nurse practitioners, and midwives. All students should first learn to do a complete environmental history before being able to use a screening history to determine whether further history is necessary based on risk factors.)
  - ▶ Occupation (or parents' occupation)
  - ▶ Temporal relationship of patient's symptoms to either home, school, day care or work environment
  - ▶ Known exposure of patient to pesticides, solvents, or other chemicals

### Points of Insertion

#### ■ Nursing

- ▶ Assessment courses, both baccalaureate and master's level
- ▶ Adult Health Nursing courses (didactic and clinical)
- ▶ Community Health or Public Health Nursing courses (didactic and clinical)
- ▶ Occupational Health Nursing clinical rotations

#### ■ Medicine

- ▶ Undergraduate Medicine
- ▶ 1st or 2nd year introduction to Patient Assessment/ Clinical Medicine, etc.
- ▶ Material should be reinforced during 3rd year clinical rotations

\* An asterisk denotes material for residents and nurse practitioner students over and above that of the undergraduate.

## II-2. Differential Diagnosis: Be able to consider pesticides in a differential diagnosis of poisoning.

### Content (Medicine and Advanced Practice Nurses)

- Know that pesticide exposures may result in health effects similar to other diseases. Signs and symptoms of pesticide over-exposure may be non-specific. With few exceptions, there are no pathognomonic signs of pesticide exposure.
- \*Knowing that many signs and symptoms of pesticide-related illness are non-specific and may be due to a variety of causes, it is important for the clinician to be able to consider pesticides in the differential diagnosis. Know agents that cause:
  - ▶ Cardiac arrhythmias
  - ▶ Altered mental status
  - ▶ Seizures
  - ▶ Pulmonary edema
  - ▶ Bloody diarrhea
- \*Know some of the most helpful diagnostic signs and symptoms (These are common examples rather than a comprehensive list; these signs and symptoms are also not exclusive to the pesticides listed.)
  - ▶ Miosis: cholinesterase inhibitors
  - ▶ Mydriasis: cyanide / fluoride
  - ▶ Peripheral neuropathy: arsenic and organophosphates
  - ▶ Methemoglobin: sodium chlorate, creosote
  - ▶ Paresthesias: pyrethroids
- \*Know the indications of when to perform cholinesterase testing.

### Points of Insertion

- Nursing
  - ▶ Assessment courses at master's level
  - ▶ Adult Health Nursing courses (didactic and clinical)
  - ▶ Child Health / Pediatric courses (didactic and clinical)
  - ▶ Community Health or Public Health Nursing courses (didactic and clinical)
  - ▶ Occupational Health Nursing courses (didactic and clinical)
- Undergraduate Medicine
  - ▶ 2nd year, Pharmacology, Pathology, and Physical Diagnosis courses
  - ▶ 3rd year during clinical rotations
  - ▶ ER rotations, Environmental Medicine elective during 4th year
- Residents
  - ▶ ICU rotations, ER and inpatient rotations

\* An asterisk denotes material for residents and nurse practitioner students over and above that of the undergraduate.

Extensive resources on pesticides can be found at [www.neetf.org/Health/Resources/healthcare.htm](http://www.neetf.org/Health/Resources/healthcare.htm)

## II-3. Signs and Symptoms: Recognize signs and symptoms of pesticide over-exposure, especially widely used cholinesterase-inhibitors and pyrethroid insecticides.

### Content (Medicine)

#### ■ Cholinesterase inhibitors (organophosphates and carbamates)

- ▶ Acute Poisoning: Know that patient will exhibit signs and symptoms of cholinergic toxicity, including salivation, lacrimation, diarrhea, nausea and vomiting, miosis with blurred vision, fasciculations, seizures, bradycardia, bronchorrhea, pulmonary edema, bronchospasm, dizziness, headache, toxic psychosis.
- ▶ Tachycardia and hypertension may initially occur due to ACh stimulation of nicotinic fibers.
- ▶ Life-threatening presentation includes a loss of consciousness, incontinence, seizures, and respiratory depression.
- ▶ \*Children: Know that children's presentation may be different from adults:
  - ▶ Children are much more likely to present with lethargy, coma, seizures than adults
  - ▶ Other typical cholinergic signs, especially the hyper-secretory signs, were found less likely to occur at initial presentation in several case series
- ▶ \*Chronic pesticide toxicity may go unrecognized because of failure to obtain a thorough exposure history. Some exposures are complex, signs and symptoms are nonspecific, and may be similar to other chronic illnesses. Consultation with specialists may be indicated for timely or optimal diagnosis and treatment.
- ▶ Know what organophosphate-induced delayed neuropathy (OPIDN) is:
  - ▶ Chiefly manifested by weakness, paralysis, and paresthesias, especially of lower extremities
  - ▶ Other symptoms of chronic toxicity to organophosphates may include headache, blurred vision, muscle weakness, depression, memory and concentration problems, irritability, and intolerance to selected chemicals

#### ■ Pyrethroids

- ▶ Know that within the class of pyrethroids, the sub-category of cyano-pyrethroids is more toxic.
- ▶ Know that the most severe toxicity is to the central nervous system, but that it occurs less frequently than other signs and symptoms.
- ▶ Seizures and disturbed level of consciousness are the chief signs.
- ▶ Know that paresthesias are a common presenting sign.
- ▶ Know that sensitization and allergic reactions also have been reported.
- ▶ \*Know that several additional signs and symptoms may mimic organophosphate toxicity:
  - ▶ Vomiting and diarrhea
  - ▶ Salivation and pulmonary edema
  - ▶ Muscle fasciculations
- ▶ \*Know that pyrethroid poisoning has been misdiagnosed as organophosphate poisoning

\* An asterisk denotes material for residents and nurse practitioner students over and above that of the undergraduate.

and that patients have been given very high doses of atropine, unnecessarily resulting in atropine toxicity.

### Points of Insertion

#### ■ Undergraduate Medicine

- ▶ 2nd year Pharmacology and Pathology courses
- ▶ 3rd year clinical rotations
- ▶ 4th year ER rotations and Environmental Medicine elective (or equivalent)

#### ■ Residents

- ▶ ICU rotations
- ▶ ER and inpatient rotations

#### ■ Nurse Practitioners

### Resources for Competency II

ATSDR Case Studies in Environmental Medicine, Agency for Toxic Substances and Disease Registry, [www.atsdr.cdc.gov/HEC/CSEM](http://www.atsdr.cdc.gov/HEC/CSEM)

He R, Wang S, Lui L, et al. Clinical manifestations and diagnosis of acute pyrethroid poisoning. *Arch Toxicol* 1989;63:54-8.

Jamal JA. Neurological syndromes of organophosphorus compounds. *Adverse Drug React Toxicol Rev* 1997 Aug;16(3):133-70.

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

Marrs TC. Organophosphate poisoning. *Pharmac Ther* 1993;58:51-66.

Osorio AM. Environmental and occupational history. In: Reigart JR, Roberts JR. *Recognition and Management of Pesticide Poisoning*, 5th ed. Washington, DC: U.S. Environmental Protection Agency; 1999. EPA#735-R-98-003.

Reigart JR, Roberts JR. *Recognition and Management of Pesticide Poisonings*, 5th ed. Chapters 3-5, 8, Index of signs and symptoms, pp. 210-22. Washington, DC: U.S. Environmental Protection Agency; 1999. EPA#735-R-98-003. **Online:** <http://npic.orst.edu/rmpp.htm>

Rosenstock L, Cullen M. *Textbook of Clinical Occupational and Environmental Medicine*, Chapter 1. Philadelphia, PA: W.B. Saunders Company; 1994.

Savage E, Keefe T, Mounce L, et al. Chronic neurological sequelae of acute organophosphate pesticide poisoning. *Archives Environmental Health* 1988;43:38-45.

Steenland K, Jenkins B, Ames RG, et al. Chronic neurological sequelae to organophosphate poisoning. *Amer J Pub Health* 1994;84:731-6.

Zwiener RJ, Ginsburg CM. Organophosphate and carbamate poisoning in infants and children. *Pediatrics* 1988;81:121-126.



# Competency III:

## Treatment, Intervention, and Referrals

### III-1. Treatment: Be able to effectively treat health conditions related to pesticide over-exposures.

#### Content (Medicine)

- Know that supportive therapy is often the mainstay in treating the pesticide-poisoned patient.
- Understand the general principles of airway control in managing a pesticide-poisoned patient:
  - ▶ \*Be able to intubate the patient and provide emergency ventilation (residents, selected advance practice nurses)
  - ▶ \*Understand pesticide-specific instances with regard to O<sub>2</sub>:
    - ▶ Organophosphates/Carbamates: adequate oxygenation is essential prior to administering atropine.
    - ▶ Diquat / Paraquat: Oxygen is contraindicated in the early stages due to progressive oxygen toxicity to lung tissue.
- Understand principles of gastrointestinal decontamination:
  - ▶ Know the uses, indications, and contraindications for each of the following: syrup of ipecac, gastric lavage, catharsis, & activated charcoal.
  - ▶ Know that ipecac is no longer recommended for routine use in most poisonings.
  - ▶ \*Know proper dosage of activated charcoal.
  - ▶ \*Know that if a second dose of activated charcoal is needed in children, it should be with-out a cathartic to avoid sudden electrolyte shifts.
- Understand principles of seizure management:
  - ▶ Diazepam is used in many of the reported pesticide poisonings including organochlorines and others.
  - ▶ Lorazepam is now being recognized as the drug of choice for status epilepticus, although there are few reports of its use with certain pesticides.
  - ▶ \*Know that with organochlorine poisoning, seizures can be refractory and may require several medications and possibly pentobarbital coma.
- \*Be able to provide necessary cardiac life support.
- \*Understand that decontamination, life support, and emergency care may need to be provided concurrently.

\* An asterisk denotes material for residents and nurse practitioner students over and above that of the undergraduate.

- Know that many signs and symptoms are non-specific and many agents have no specific antidotal treatment.
- Understand special treatments required for certain pesticides:
  - Organophosphates and Carbamates
    - Know that tissue oxygenation must be improved as much as possible prior to giving atropine.
    - \*Know required atropine dose and dosing intervals. Be aware that the dose for cholinesterase-inhibiting insecticides is much higher than that for cardiac resuscitation.
    - \*Know the indications for pralidoxime.
    - \*Know that pralidoxime is usually not needed for carbamates because the enzyme-pesticide complex rapidly dissociates; therefore atropine alone is effective.
  - Pyrethroids
    - Be able to provide supportive therapy.
    - \*Know that Vitamin E oil preparations may prevent or stop paresthesias.
  - \*Arsenicals
    - Know that initial chelation is performed using dimercaprol (BAL) as an intramuscular injection.
    - After gastrointestinal tract is free of arsenic, one may consider an oral chelating agent such as DMSA ("Succimer"), which is available in the U.S. but not labeled for this use.
  - \*Organomercury Compounds (fungicides)
    - DMSA ("Succimer") is probably the most effective agent available in the U.S.
  - \*Hydrogen Cyanide and Acrylonitrile (transformed to hydrogen cyanide)
    - Amyl nitrite by inhalation 15-30 seconds of every minute.
    - Sodium nitrite 3%; 10 mL given I.V. over 5 minutes.
    - Sodium thiosulfate 50ml of 25 % solution given I.V. over 10 minutes.
    - The above antidotes are commercially available as the Lilly Cyanide Antidote Kit.
  - \*Rodenticides (specifically "superwarfarins" such as brodifacoum)
    - For ingestion larger than about 1 mouthful, prothrombin time (PT) is currently recommended at 24 to 48 hours post-ingestion.
    - More recent data suggest that if a known quantity (small amount) is unintentionally ingested, PT measurement may not be necessary.
    - Phytonadione (vitamin K1) is given for an elevated PT or signs of bleeding.
    - If taken during the preceding 15 days, determine patient's PT and give vitamin K1 intramuscularly if PT is significantly prolonged.
    - Intravenous vitamin K1 should be reserved for patients with active bleeding only, due to potential severe side effects.

\* An asterisk denotes material for residents and nurse practitioner students over and above that of the undergraduate.



## Points of Insertion

### ■ Nursing

- ▶ Adult Health Nursing courses (didactic and clinical). Undergraduate nursing students should be able to recognize and provide supportive care to patients with pesticide poisoning. Advanced practice nurses, especially primary care nurse practitioners and occupational health nursing practitioners, should be able to diagnose and treat patients with pesticide poisoning.
- ▶ Community Health, Public Health Nursing, or Pediatric Nursing courses (didactic and clinical)
- ▶ Environmental Health Nursing elective

### ■ Undergraduate Medicine

- ▶ 2nd year Pharmacology and Pathology courses
- ▶ 3rd year clinical rotations
- ▶ 4th year ER rotations, Environmental Medicine elective

### ■ Residents

- ▶ ICU rotations
- ▶ ER and inpatient rotations

## III-2. Intervention: Be able to advise health care providers on decontamination of patients and the environment following over-exposure.

### Content (Medicine, Advanced Practice Nursing, and Specialty Environmental Health Nursing)

- Advise other health care providers on how to decontaminate patients and the environment following over-exposure.
  - ▶ Understand principles of skin decontamination, flushing eyes with water.
  - ▶ Understand proper clothing and precautions for emergency personnel, including goggles and rubber gloves.
  - ▶ Be aware that pesticide contamination can occur on the insides of boots and gloves.
- Understand that site decontamination needs to occur. Examples include:
  - ▶ Environmental exposure at home or school with excess pesticide residue
  - ▶ Hospital exposure to personnel resulting in toxicity to health care providers

## Points of Insertion

### ■ Nursing

- ▶ Advanced Adult Health Nursing courses (didactic and clinical)
- ▶ Advanced Community Health or Public Health Nursing courses
- ▶ Environmental Health Nursing elective

### ■ Undergraduate Medicine

- ▶ 2nd year Pharmacology and Pathology courses
- ▶ 3rd year clinical rotations
- ▶ 4th year ER rotations, Environmental Medicine elective

### ■ Residents

- ▶ ICU rotations
- ▶ ER and inpatient rotations

### Resources for Competencies III-1 and III-2

ATSDR Case Studies in Environmental Medicine, Agency for Toxic Substances and Disease Registry, [www.atsdr.cdc.gov/HEC/CSEM](http://www.atsdr.cdc.gov/HEC/CSEM)

Helmuth RA, McCloskey DW, Doedens DJ, et al. Fatal ingestion of a brodifacoum-containing rodenticide. *Lab Med* 1989;20:25-7.

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

Lieske CN, Clark JH, Maxwell DM, et al. Studies of the amplification of carbaryl toxicity by various oximes. *Toxicology Letters* 1992;62:127-137.

Lipton RA, Klass EM. Human ingestion of a "superwarfarin" rodenticide resulting in a prolonged anticoagulant effect. *JAMA* 1984;252:3004-5.

Muckter H, Liebl B, Beichl FX, et al. Are we ready to replace dimercaprol (BAL) as an arsenic antidote? *Hum Exp Toxicol* 1997;16:460-5.

Mullins ME, Brands CL, Daya MR. Unintentional pediatric superwarfarin exposures: Do we really need a prothrombin time? *Pediatrics* 2000;105:402-4.

Reigart JR, Roberts JR. *Recognition and Management of Pesticide Poisonings*, 5th ed. Washington, DC: U.S. Environmental Protection Agency; 1999. EPA#735-R-98-003. Online: <http://npic.orst.edu/rmpp.htm>

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

Thompson DF, Thompson GD, Greenwood RB, Trammel HL. Therapeutic dosing of pralidoxime chloride. *Drug Intelligence and Clinical Pharmacy* 1987;21:590-3.

Tucker SB, Flannigan SA, Ross CE. Inhibitions of cutaneous paresthesia resulting from synthetic pyrethroid exposure. *Int J Dermatol* 1984;10:686-9.

### **III-3. Referrals: Understand when to make referrals to appropriate occupational / environmental health specialists.**

#### **Content**

- The student should be able to make appropriate judgments of when, where, why, and to whom the patient should be referred. Treatment of pesticide exposure may be beyond the scope of practice for the provider. Consultation and referral to a specialist in the field of environmental and occupational health can facilitate timely diagnosis and optimal treatment. For more severe health events that involve numerous individuals, additional assistance can be obtained from the state health department or a state regulatory agency.
- Know how to contact (via national, regional, state, and local professional organizations and websites), and be able to compare and contrast the role, scope of practice, and setting of, the following environmental/occupational health specialists:
  - ▶ cooperative extension
  - ▶ environmental health specialist
  - ▶ industrial hygienist
  - ▶ occupational health nurse
  - ▶ occupational health nurse practitioner
  - ▶ occupational medicine physician

### **III-4. Follow-up: Know how to arrange appropriate patient follow-up.**

#### **Content**

- Understand appropriate follow-up of patients who have had pesticide poisoning.
- Know that patients with organophosphate poisoning may need later neurologic follow-up.

#### **Points of Insertion for III-3 and III-4**

- Nursing
  - ▶ Leadership in nursing
  - ▶ Clinical nursing rotations such as Adult Health, Pediatrics, Maternal-Child Health Nursing
  - ▶ Community Health or Public Health Nursing courses (didactic and clinical)
  - ▶ Environmental Health Nursing or Emergency Nursing elective
- Medicine
  - ▶ 3rd year clerkships in Family Medicine, Pediatrics, or Internal Medicine
  - ▶ 4th year elective in Environmental Medicine or Emergency Medicine

■ Residency

► Primary care

### Resources for Competencies III-3 and III-4

Hitchcock J, Schubert P, Thomas S. *Community Health Nursing*. Albany: Delmar Publishers; 1999; 15-16.

Institute of Medicine. *Role of the Primary Care Physician in Occupational and Environmental Medicine*. IOM Report, Division of Health Promotion and Disease Prevention, Washington, DC: National Academy Press; 1988.

Pope AM, Snyder M, Mood L, for Committee on Enhancing Environmental Health Content in Practice, Institute of Medicine. *Nursing, Health, and the Environment: Strengthening the Relationship to Improve the Public's Health*, Chapter 3. Washington, DC: National Academy Press; 1995; 17-8.

Rogers B. *Occupational Health Nursing Concepts and Practice*. Chapter 4. Philadelphia, PA: W.B. Saunders Company; 1994.

Rosenstock L, Cullen M. *Textbook of Clinical Occupational and Environmental Medicine*, Chapters 1, 10. Philadelphia, PA: W.B. Saunders Company; 1994.

# Competency IV:

## Risk Communication

### IV-1. Patient Education: Be able to educate patients about basic routes of exposure and absorption, and how to minimize exposure to pesticides.

#### Content

- Healthy People 2000 / 2010 Objective 11. Environmental Health
- Be able to discuss examples of potential exposure, routes of exposure, and absorption in lay person's terms, and be able to incorporate them into patient teaching that is appropriate to the patient/family.
- Be able to counsel patients about minimizing unnecessary use of pesticides.
- Be able to provide anticipatory guidance about signs, symptoms, and recognition of pesticide exposure, and safe use of pesticides including hygiene practices, reading labels, and protective clothing.
- Be able to assess and discuss risks of patient exposure to pesticides and to develop individualized strategies for patient and family for reducing risk of exposure (See Pesticide Safe Use Checklist on page 49):
  - ▶ Safeguard homes during pesticide applications
  - ▶ Mitigating risks to family during and following an application
  - ▶ For patients who work with pesticides: use of personal protective clothing and equipment, decontamination procedures, preventing residues from being brought home on clothing.
- Be able to counsel patients who are pregnant or planning a pregnancy that some pesticides have adverse reproductive risks, and the desirability of switching to other tasks, if possible, at least during the first trimester of pregnancy.
- Be able to describe the purpose and function of available resources and know when to refer patients to the following:
  - ▶ Local health department
  - ▶ Cooperative extension services
  - ▶ Primary care provider
  - ▶ Poison Control Center
  - ▶ EMS



## Points of Insertion

### ■ Nursing

- ▶ Adult, Pediatric, Maternal-Child Health Nursing courses (didactic and clinical) at both undergraduate and graduate levels
- ▶ Community Health or Public Health Nursing courses (didactic and clinical)
- ▶ Primary Care Management courses (didactic and clinical)
- ▶ Elective in Environmental Health Nursing
- ▶ Midwifery

### ■ Undergraduate Medicine

- ▶ 3rd year clerkships in Pediatrics, Internal Medicine, Family Medicine
- ▶ 4th year elective in Preventive Medicine
- ▶ OB-GYN rotations

### ■ Residency

- ▶ Environmental Medicine rotation
- ▶ Primary Care clinics
- ▶ Occupational/Environmental Medicine

## IV-2. Labels: Be able to advise patients on how to read pesticide labels.

### Content

- Know the components of a pesticide label that patients should look for:
  - ▶ Pay special attention to the precautionary statements and physical hazards.
  - ▶ Know what the "signal word" is to determine level of toxicity.
  - ▶ Know what types of first aid are indicated and contraindicated.
- Know that it is a violation of the law to use pesticides in a manner other than as stated on the label.
- Be able to teach patients to read labels and follow instructions carefully:
  - ▶ Discuss the dangers of altering mixing and application procedures.
  - ▶ Discuss the need for wearing appropriate protective clothing, masks, and other personal protective equipment (PPE), as instructed on product labels.
  - ▶ Discuss the need to be prepared for emergencies and to ensure that necessary equipment, supplies, etc., are available and in proper working order.
  - ▶ Teach patients to post telephone numbers nearby for EMS and Poison Control Center.
- Be aware that there may be specific patient populations that will have limitations in reading the label (illiterate, non-English speaking, etc.) and special preventive education will be necessary.

## Points of Insertion

### ■ Nursing

- ▶ Community Health or Public Health Nursing course (didactic and clinical)
- ▶ Home Health Nursing courses (didactic and clinical)
- ▶ Maternal-Child Health Nursing, Obstetric Medicine rotations
- ▶ Pediatric Nursing courses (didactic and clinical)
- ▶ Adult Health Nursing courses (didactic and clinical)
- ▶ Elective course in Environmental Health Nursing
- ▶ Midwife training courses

### ■ Undergraduate Medicine

- ▶ 3rd year clerkships in Pediatrics, Internal Medicine, Family Medicine
- ▶ 4th year elective in Preventive Medicine
- ▶ OB/GYN rotations

### ■ Residency

- ▶ Environmental Medicine rotation
- ▶ Anticipatory guidance in Primary Care clinics
- ▶ Occupational/Environmental Medicine residency

## Resources for Competency IV

### ■ Online Resources

- ▶ U.S. EPA, Read the Label First: [www.epa.gov/pesticides/label/](http://www.epa.gov/pesticides/label/)  
Integrated Pest Management: [www.epa.gov/opbtpd1/ipm/index.htm](http://www.epa.gov/opbtpd1/ipm/index.htm)
- ▶ National Pesticide Information Center: Public access to pesticide information; supported by EPA. Tel: (800) 858-7378 (M-F, 8 am - 6 pm CST). <http://npic.orst.edu/gen.htm#ps>
- ▶ NEETF Pesticides Resource Library: [www.neetf.org/Health/Resources/healthcare.htm](http://www.neetf.org/Health/Resources/healthcare.htm)

### ■ Publications

- ▶ Hitchcock J, Schubert P, Thomas S. *Community Health Nursing*. Albany: Delmar Publishers; 1999;15-16.
- ▶ Institute of Medicine. *Role of the Primary Care Physician in Occupational and Environmental Medicine*. IOM Report, Division of Health Promotion and Disease Prevention, Washington, DC: National Academy Press; 1988.
- ▶ Pope AM, Snyder M, Mood L, for Committee on Enhancing Environmental Health Content in Practice, Institute of Medicine. *Nursing, Health, and the Environment: Strengthening the Relationship to Improve the Public's Health*, Chapter 3. Washington, DC: National Academy Press; 1995; 17-8.
- ▶ Rogers B. *Occupational Health Nursing Concepts and Practice*. Chapter 4. Philadelphia, PA: W.B. Saunders Company; 1994.
- ▶ Rosenstock L, Cullen M. *Textbook of Clinical Occupational and Environmental Medicine*, Chapters 1, 10. Philadelphia, PA: W.B. Saunders Company; 1994.

## PESTICIDE SAFE USE CHECKLIST

### BEFORE USING A PESTICIDE:

- Check the label to:
  - ▶ be sure the pest you need to control is listed on the label;
  - ▶ be sure the site or plant to which you intend to apply the pesticide is listed on the label;
  - ▶ see if any special protective clothing or equipment is necessary;
  - ▶ find out what equipment to use to apply the pesticide;
  - ▶ see whether the pesticide is toxic to certain plants -- it may be necessary to remove or cover plants;
  - ▶ be sure you are applying the pesticide at the right time.
- Buy only enough pesticide for one, or at most, two years. Pesticides stored longer may degrade and become less effective.
- Remove or cover pet food and water dishes and fish tanks.

### DURING APPLICATION:

- Always wear long trousers, a long-sleeved shirt, socks, and shoes when applying any pesticide. Other protective equipment, such as gloves, boots, a respirator, or goggles, may be necessary or desirable for extra protection.
- Do not wear leather shoes, boots, or gloves while handling pesticides. Leather absorbs pesticides and cannot be decontaminated easily.
- Take care to avoid pesticides coming into contact with your eyes, mouth, or skin.
- Avoid breathing spray mists. Open the windows when spraying indoors.
- Keep children and pets out of the treated area until the spray has dried or the dust has settled; longer if the label lists a longer reentry period.
- Wash your hands with soap and water before eating, smoking, or using the toilet.
- Stand upwind while mixing and applying pesticides.
- Never apply a pesticide where it could contact food, utensils, or food preparation areas, unless the label allows for such contact.
- If you are applying the pesticide to a food crop, check the label to see how many days you must wait before harvesting.
- Unless the label specifically allows such use, never apply a pesticide where it could contact water sources and avoid applying to bare ground.
- Follow label directions for method of application carefully. When practical, use spot treatments rather than broadcast sprays. If the label specifies "crack and crevice" treatment, apply only as a very narrow band.
- Never apply a pesticide at a higher rate than the label directs.

### AFTER USING A PESTICIDE:

- Wash your hands with soap and water immediately after applying a pesticide. Shower as soon as possible.
- Wash all clothing worn during mixing and application separately from household laundry. Use a heavy duty liquid detergent and hot water. Dry the clothes in a hot dryer or outside in the sun.
- Keep pesticide measuring utensils separate from household and kitchen utensils.
- Store pesticides only in their original containers. Keep them away from food, feed, seed, and fertilizers in a locked building or cabinet.
- Dispose of empty pesticide containers in accordance with label directions and state and local requirements.

Source: Amy Brown, Maryland Cooperative Extension, Pesticide Education and Assessment Program, <http://pesticide.umd.edu>

# Competency V:

## Reporting Requirements and Regulations

### Content

#### **V-1. Surveillance Needs: Understand the importance of surveillance and incident reporting.**

- Understand surveillance as the systematic collection and evaluation of all aspects of exposure occurrence and sequelae resulting in information that may be useful in the control of the exposure. To be effective, surveillance should be linked to preventive action.
- Be aware of cases of pesticide exposure and monitoring data on trends of exposure.
- Be able to describe strategies, both individual patient focused and population-based, that may result in reduced exposure.
- Be able to compare and contrast surveillance versus screening.
- Understand the relationship between incident reporting and workers' compensation process, including when to report and to whom to report.
- Understand the ethical / legal requirements of the nurse and physician for reporting pesticide exposures and be able to cite regulations, OSHA standards, etc.
- Understand relevant OSHA standards and the 1994 Worker Protection Standard, as well as additional requirements for workers in greenhouses and nurseries, and for early-entry workers.
- Be able to briefly describe the NIOSH Sentinel Event Notification System for Occupational Risks (SENSOR) system.

#### **V-2. Reporting: Know how to participate in mandatory state surveillance systems and reporting requirements.**

- Know that eight states conduct pesticide poisoning surveillance, and that at least 25 have some form of pesticide poisoning reporting requirements.
- Be able to briefly describe the rules and regulations regarding surveillance and reporting in the student's current state.
- Be knowledgeable about local, county, state, and national agencies for reporting of pesticide exposure, and about how to access state reporting data.

- Given a scenario, the student should be able to briefly describe his/her responsibilities and the process for reporting a pesticide exposure, and give a rationale for his/her actions, including regulatory and ethical considerations.

### **V-3. Regulations: Understand other legal and regulatory provisions that have implications for health care providers.**

- Know that several laws administered by EPA, FDA, and OSHA regulate the use and sale of pesticides to protect human health.
- Understand the role and functions of EPA in the regulation of pesticide use under the Federal Insecticide, Fungicide, and Rodenticide Act.
- Understand the role, jurisdiction, and function of the Occupational Safety and Health Administration (OSHA) relative to workplace pesticide exposures.
- Know about EPA's Worker Protection Standard and the two types of workers to whom it affords protection in the farming, greenhouse, nursery and forest industries: (1) agricultural pesticide handlers (mixers, loaders, applicators, equipment cleaners or repair persons, and flaggers) and (2) field workers (cultivators or harvesters).
- Understand EPA's role relative to pesticide contamination of water and implications for migrant farmworkers.

### **V-4. \*Legal Framework: Understand framework of federal laws that address pesticides and pesticide exposures.**

(\*Advanced nurse practitioner/resident or fellow)

- FIFRA: Federal Insecticide, Fungicide, Rodenticide Act (1947)
  - ▶ Provides definition of pesticide
  - ▶ Establishes pesticide label as law
  - ▶ Enables EPA to take action against pesticides considered to present unreasonable risks to human health
- FFDCA: Federal Food, Drug, and Cosmetic Act
  - ▶ Establishes concept of a tolerance, the maximum level of pesticide residue at harvest, for pesticide residue on human food and animal feed
  - ▶ Requires EPA to set tolerance levels
- FQPA: Food Quality Protection Act
  - ▶ Amends FIFRA and FFDCA
  - ▶ Establishes health-based standard for all pesticides
  - ▶ Provides additional ten-fold safety factor for infants and children

- ▶ Requires EPA to review pesticide registrations
  - ▶ Requires consideration of cumulative exposure
  - ▶ Requires reasonable certainty that pesticides are not causing harm
- WPS: Worker Protection Standard
  - ▶ EPA regulation issued under FIFRA
  - ▶ Provides protection to pesticide handlers and agricultural workers
  - ▶ Requires employer to ensure safety for all workers
- OSHA: Occupational Safety and Health Act
  - ▶ Provides for worker safety in manufacture, formulation, and distribution of pesticides
  - ▶ Establishes "Right-to-Know" law, whereby employers furnish employees information on hazardous chemicals they may be exposed to at work
  - ▶ Administered by Occupational Safety and Health Administration
- TSCA: Toxic Substances Control Act
  - ▶ Establishes an inventory of chemical substances
  - ▶ Requires manufacturers of chemicals to submit test results to EPA
  - ▶ Allows EPA to regulate new and existing commercial chemicals based on their risk to health or the environment

## **V-5. Ethical, Legal, Advocacy: Understand ethical, legal, and advocacy roles of health care providers in pesticide exposure incidents.**

- Be able to identify vulnerable, at-risk populations relative to a potential exposure to a pesticide, e.g. children, adults working in selected occupations including mixer/handlers, applicators, farmers, pregnant women, migrant farmworkers, medical workers.
- Understand concept of environmental justice and its implications for vulnerable populations and for the role of health care providers.
- Given a scenario, the student should be able to write a position paper to a specific agency regarding the pesticide exposure, addressing the health, cultural, social, ethical, legal, economic, and political factors related to the issue for the vulnerable population, and describing the roles of the health care provider.

### **Points of Insertion**

- Nursing
  - ▶ Ethical, legal, public policy course or units of instruction (undergraduate and graduate levels)
  - ▶ Community Health or Public Health Nursing courses
  - ▶ Occupational Health Nursing
  - ▶ Elective in Environmental Health Nursing (undergraduate and graduate levels)

- ▶ Leadership in Nursing (undergraduate and graduate levels)
- ▶ Role course/unit of instruction or module (undergraduate and graduate levels)

#### ■ Medicine

- ▶ Public Sector Medicine rotation
- ▶ 4th year elective and residency elective in Environmental Medicine or Preventive Medicine
- ▶ Occupational/Environmental Medicine or Primary Care residency

#### Resources

National Pesticide Information Center: <http://npic.orst.edu>

NEETF Pesticides Resource Library: [www.neetf.org/Health/Resources/healthcare.htm](http://www.neetf.org/Health/Resources/healthcare.htm)

U.S. EPA: Laws and Regulations, <http://www.epa.gov/epahome/lawreg.htm> [www.epa.gov/pesticides/regleg.htm](http://www.epa.gov/pesticides/regleg.htm). Pesticide Management Resource Guide: [www.epa.gov/oppfead1/pmreg/index.html](http://www.epa.gov/oppfead1/pmreg/index.html). Worker Protection Standard and Recent Amendments: [www.epa.gov/pesticides/safety/workers/amendmnt.htm](http://www.epa.gov/pesticides/safety/workers/amendmnt.htm)

\* An asterisk denotes material for residents and nurse practitioner students over and above that of the undergraduate.

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