1. Introduction

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1.1 A Guide to the Manual

1.1.1 Goal

This manual will help State health departments develop and maintain surveillance programs for acute and subacute health effects from pesticide exposure. It provides guidelines for program development, case investigation, data collection, outreach, and education. A list of resources for further information is also provided. The manual (which provides the case classification scheme, severity index, and sample data collection forms in the appendices), the standardized variables, and the SENSOR* pesticide incident data entry and reporting (SPIDER) computer program software described in the manual are intended to simplify and streamline the surveillance system development process. Adoption of these tools will allow a State to pool data with other State-based pesticide poisoning surveillance systems. Many tools and techniques covered in this manual may be generalized for surveillance of other occupational and environmental illnesses and injuries.

The manual is designed to address issues of capturing illnesses and injuries from pesticide exposures in workplace and nonworkplace settings. Pesticide poisoning is a complex condition for surveillance. It encompasses many illnesses and injuries created by single or mixed exposures to pesticide products. Pesticide products are often mixtures composed of pesticides and other ingredients that may have adverse human health impacts. The complex nature of pesticide poisoning and technical resources needed for case investigation warrants the development of surveillance programs based predominantly in State health departments or other State-level agencies.

1.1.2 How to Use the Manual

Surveillance of acute pesticide-related illness and injury requires a multidisciplinary approach that includes careful planning and implementation. This manual will be most useful when read in sequence—Chapter 1 through Chapter 9 and Appendix G—before implementing surveillance. Additional information that will be useful both in the initial phases of development and the ongoing implementation of the surveillance system is provided in the appendices. Readers working with established pesticide-related illness and injury surveillance programs can also use the manual to enhance their surveillance program and to find additional resources on pesticides.

1.1.3 Limits of the Manual

The surveillance system described here is not designed to address case and cluster reports of chronic health effects potentially associated with pesticide exposure (e.g., cancer, reproductive outcomes, or immunologic and neurologic effects of chronic exposure). While providing general guidance about parameters necessary for an effective pesticide poisoning surveillance system, it is not intended to cover every situation or to be a complete manual of standard operating procedures.

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*SENSOR is the Sentineal Event Notification System for Occupational Risk.

1.2 INTRODUCTION TO THE PROBLEM

1.2.1 PROBLEM OVERVIEW

Over the past 20 years, concern about environmental health issues have increased, particularly in the area of pesticide exposure. These concerns have created a growing demand for health and environmental agencies to provide data on the impacts of pesticide exposure on human and environmental health.

Pesticides are toxic to certain life forms by design. In addition, they have the potential to cause adverse health impacts on humans and other nontarget species. The U.S. Environmental Protection Agency (EPA) has responsibility for ensuring that proper pesticide use does not pose unacceptable risks to humans and the environment. A variety of risk assessment tools are used to evaluate pesticide products, including both laboratory tests and field trials. The monitoring of acute illnesses associated with pesticide use is an important additional tool for identifying potential problems and populations at high risk, and to develop and evaluate risk reduction strategies.

1.2.1.1 THE CHANGING PATTERNS OF PESTICIDE USE

Pesticide use has expanded dramatically since the discovery of dichloro-diphenyl-trichloroethane (DDT) in 1939. Approximately 16,000 pesticide products are registered with the EPA. These products are based on approximately 600 active ingredients. Most pesticide products (approximately 80% by volume) are used by the agricultural industry [Donaldson et al. 2002]. In addition, a broad range of nonagricultural pesticide products are formulated for home, garden, structural, veterinary, antimicrobial, and insect repellent purposes.

Over time, the use of the most toxic pesticides has been decreasing as have the numbers of pesticide-related deaths and more severe poisonings. Advances in technology and the push for a more ecological approach to pest management will continue to shift the types of pesticides used over time. The current trend is toward greater use of biopesticides (microorganisms and pheromones) [NAS 2000]. Monitoring any adverse effects of these products on human and animal population health will be important. While these products currently represent only a small portion of the market, they are expected to play a larger role in the future. In addition, less toxic conventional pesticides will continue to be used.

1.2.1.2 SCOPE OF THE PROBLEM

From 1993 through 1996, a total of 63,583 symptomatic poisonings from pesticides other than disinfectants were reported to the Toxic Exposure Surveillance System (TESS) [Calvert et al. 2001] and followed to determine a medical outcome. Of these, 16,258 (25%) were among children aged 6 and under. Workplace pesticide exposure accounted for 6,323 cases. According to TESS, an additional 22,889 poisonings were attributed to disinfectant exposures. These numbers exclude intentional poisonings such as malicious use or suicide. Suicides and misuse represent a relatively low proportion of reported TESS cases. The data from the TESS system are an indicator of the size of the problem of pesticide-related illness and injury in the United States. During the same time period, however, 3,143 occupationally related cases classified as definite probable or possible were reported to the California Department of Pesticide Regulation (CDPR) [CDPR 2002], suggesting that TESS may underestimate occupational illnesses by several fold.

1.2.1.3 Susceptibility to Pesticide Poisoning

The terms *pesticide poisoning* and *pesticide-related illness* are used interchangeably throughout this manual. These terms refer to acute and subacute illness or injury resulting from pesticide exposure. Whether pesticide exposure produces health effects in humans depends on the agent, the exposure scenario, and individual susceptibility. Agent-specific factors include the inherent toxicity of the pesticide, the physical characteristics of the formulation, and the presence of other compounds (e.g., adjuvants, carriers, emulsifying agents). Relevant exposure scenario factors include the dose (concentration and amount), route of exposure, duration and frequency of exposure, environment (heat, humidity, protective equipment), and any concurrent exposure to other substances. Individual susceptibility is influenced by many factors including age, sex, genetic composition, diet, and general health (e.g., presence of pre-existing illness). Health effects may result from acute or chronic exposure to high or low levels of pesticide products. Pesticide exposure may result in a wide range of symptoms dependent on the factors mentioned above. Acute illness may be mild (e.g., headache, rash, or flu-like symptoms) or more severe, including serious systemic illness, third degree burns, neurologic effects, and, rarely, death.

Some persons may have increased susceptibility to acute pesticide poisoning. Pesticide poisoning can affect both children and adults, although children may be more susceptible because of differences in organ system function and body composition. In addition, children have behavior patterns that might increase exposure. Finally, persons with asthma or other respiratory disease may also be susceptible to exposure effects despite proper pesticide application.

Mild illnesses from pesticide exposure are frequently characterized by nonspecific signs and symptoms, mimicking flu and other common illnesses. Responses to exposure may also be due to the odor or other irritant properties of the pesticide products as opposed to actual systemic intoxication. Health effects may result from intentional misuse, unintentional exposures, or use according to the product label.

1.2.1.4 A Problem That Affects Us All

The widespread use of pesticides means that all sectors of the population are at risk of exposure. Occupationally exposed persons are at risk from exposure to more concentrated forms of pesticide if they are involved in manufacturing, reformulation, mixing, loading, or applying pesticide products. Workers who handle pesticides or pesticide-treated products risk illness arising from either chronic low-level pesticide exposure or a single acute pesticide exposure. Persons exposed to pesticides in the residential environment may have prolonged exposures if a pesticide product is misapplied to the residence or its surroundings. Children having repeated contact with pesticide-treated surfaces and those who spend large amounts of time in a treated home environment also may receive a substantial dose compared with others in the same residence. In addition, pets may serve as sentinels of exposure in these situations.

1.2.2 Why Investigate Reports of Pesticide Poisoning?

There are several reasons for addressing reports of pesticide poisoning. Although pesticide products go through an extensive battery of testing before marketing, the testing protocol does not address all environmental conditions, mixtures of chemicals, chronic exposure patterns, and host parameters that can be encountered.

Surveillance serves as an early warning system of any effects not detected by manufacturer testing. It can also identify pesticide problems caused by noncompliance with pesticide regulations.

Investigation may reveal a pattern of problems associated with a particular pesticide active ingredient or a product formulation. An investigation can determine whether a pesticide illness event arose despite use according to the pesticide label, whether it was because of a violation of label instructions, or whether the label instructions were unclear, confusing, or inaccurate. This information can be used to determine if the product was used inappropriately, or whether changes are needed in label instructions, product design, or types of personal protective equipment (PPE) necessary to prevent additional illnesses from occurring. Information gathered through investigation can be used to detect whether particular populations are at greater risk, or whether activities are associated with exposure and illness that can be modified to prevent illness.

It would be ideal to have all States conducting surveillance of pesticide poisoning. In an era of limited public health resources, however, each State must determine whether this condition is a priority for the public it serves. The decision to implement surveillance may be based on the types and quantities of pesticides used in the State for agricultural, urban, or structural pest control, or in the absence of actual pesticide use data, the prevalence of crop/agricultural or other activities associated with high pesticide use. Other local issues may also drive the need to answer questions about the potential impacts of pesticides on public health. As another option, surveillance for pesticide poisoning may be integrated into a broader poisoning surveillance system.

1.2.3 Response to the Problem

The Council of State and Territorial Epidemiologist (CSTE) recommends that acute pesticide-related illness and injury be placed under surveillance in all States [CSTE 1996]. Additionally, U.S. Government Accountability Office (GAO) reports from the last 10 years have highlighted the need for standardized surveillance of human illness associated with pesticide exposure [GAO 1994, 1999, 2000]. Finally, the American Medical Association (AMA) supports the need for improved pesticide poisoning surveillance [AMA 1997]. Thirty States have rules requiring some form of physician reporting of pesticide exposure and illness, although most of these States do not have a surveillance program to act on these reports. Nine States (Arizona, California, Florida, Louisiana, Michigan, New York, Oregon, Texas, and Washington) conduct more comprehensive case investigation and surveillance activities. States with existing surveillance systems use a variety of systems for collecting and categorizing data. One objective of this manual is to raise awareness of the importance of adopting standardized coding and categorization systems. This manual will help States initiate a comprehensive Pesticide Poisoning Surveillance Program (PPSP). States considering developing a program may wish to follow the stepwise approach shown in Figure 1.1.

The EPA collects information about pesticide poisonings by a variety of mechanisms. It receives mandated reports of adverse effects from manufacturers, and periodically reviews both the TESS data maintained by the American Association of Poison Control Centers (AAPCC) and aggregated data from State-based surveillance programs. Additionally, the EPA receives more timely reports of significant illnesses and injuries from

State surveillance programs, State regulatory programs, and/or affected persons. State-based surveillance program reporting of significant pesticide-related illnesses and injuries to the EPA is voluntary but is viewed by the participating States as an important part of exchanging information to enhance the understanding and prevention of pesticide poisonings.

The National Institute for Occupational Safety and Health (NIOSH) has an interest in developing information about occupational pesticide-related illness and injury that will lead to prevention. It has provided funding to States for the development and enhancement of pesticide-related illness and injury surveillance programs. Most States with PPSPs report aggregated data to NIOSH that are shared with EPA and the National Center for Environmental Health (NCEH) at the Centers for Disease Control and Prevention (CDC). States may also request investigation assistance from NIOSH for particular types of cases (death, multiple affected persons, incidents involving new pesticide products, and incidents that occur despite use according to the product label). This cooperation helps provide a broader view of the problem of pesticide poisoning, and participating States benefit from the knowledge gained from pooled information.

Figure 1.1. Flow diagram of PPSP development process.