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Surveillance of acute occupational pesticide-related illness and injury: the US experience

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Summary. - In the United States there are numerous state-based and national surveillance systems that collect data on acute pesticide-related illnesses and injuries. On the state level, Arizona, California, Florida, Louisiana, New York, Oregon, Texas, and Washington routinely collect illness data due to pesticide exposure and conduct comprehensive case investigations. On the national level, the American Association of Poison Control Centers coordinates the Toxic Exposure Surveillance System, and the Bureau of Labor Statistics provides annual estimates of the number of occupational pesticide-related illnesses and injuries that result in days away from work. The various systems are described and compared, and examples are provided of prevention measures that have been implemented as a result of surveillance activities.
Key words: public health surveillance, poisoning, pesticides, prevention.

Riassunto *(Sorveglianza delle intossicazioni acute da antiparassitari in ambito occupazionale: l'esperienza degli Stati Uniti).* - Negli Stati Uniti sono attivi sia a livello statale che federale diversi sistemi di sorveglianza per la rilevazione di effetti di tipo acuto conseguenti ad esposizioni ad antiparassitari. Nel presente articolo vengono descritti e messi a confronto i sistemi attivi in 8 stati (Arizona, California, Florida, Louisiana, New York, Oregon, Texas e Washington) e due sistemi attivi a livello nazionale. Questi ultimi sono costituiti dall'attività svolta dall'associazione americana dei centri anti-veleni (The Toxic Exposure Surveillance System) e dall'istituto delle statistiche sul lavoro (Bureau of Labor Statistics). Vengono, inoltre, descritte le ricadute in termini di misure preventive che questi sistemi hanno permesso di ottenere.
Parole chiave: sorveglianza di sanità pubblica, intossicazioni acute, antiparassitari, prevenzione.

Introduction

Public health surveillance is defined as the ongoing and systematic collection, analysis, and interpretation of health data to describe and monitor a health event for the purpose of planning, implementation and evaluation of public health prevention and intervention programs [1]. In the US, there are several surveillance systems for acute pesticide-related illness and injury (defined as acute toxic effects as well as local irritation to the conjunctiva, mucous membrane or skin from pesticide exposure) but there is no system on a national level that would enable a complete understanding of the problem. However, despite this limitation, data collected from the existing programs give an idea of the scope and extent of the problem and have been instrumental in both revising licensing requirements and modifying authorized uses of certain particularly toxic products. The purpose of this paper is to describe the major surveillance programs for acute pesticide-related illnesses active in the United States and to give examples of the utility of the data in prevention activities.

Description of existing surveillance systems for pesticide-related illness or injuries in the US

State-based surveillance systems

Thirty states in the United States require some form of physician, laboratory or hospital reporting of pesticide-related illness or injury [2-4]. Only eight states (Arizona, California, Florida, Louisiana, New York, Oregon, Texas, and Washington) routinely conduct more comprehensive case investigation and surveillance activities (Table 1). Besides tabulating the number of cases, these eight surveillance systems perform in-depth investigations for case confirmation, conduct screening of other workers at a case-patient's work-site and develop interventions aimed at particular industries or hazards. The surveillance program in 5 of these states (California, Florida, New York, Oregon, Texas) is partially funded by the National Institute for Occupational Safety and Health (NIOSH) through the Sentinel Event Notification System for Occupational Risk (SENSOR) program. The SENSOR program promotes state-based surveil-

lance of selected occupational conditions, including occupational pesticide-related illness and injury [5].

State-based surveillance systems for acute pesticide-related illness and injury differ from poison control centers whose main objective is to provide advice on the treatment of acute poisonings or to provide information of a general type in response to telephone calls from the public. Whereas the purpose of state-based surveillance programs in the US is not to assist with emergency therapy but rather to describe the problem and propose preventive measures, data are gathered from a variety of sources. All eight state-based surveillance systems mentioned above require physician-reporting of pesticide-related illness and injury cases. Other sources of case reports vary from state to state, and include poison control centers, emergency medical services, other health care professionals, medical laboratories, hospitals, clinics, migrant legal aid, state agencies with jurisdiction over pesticide use (e.g. state agricultural departments, state structural pest control boards) and calls from the public. The state programs also routinely review other data sources such as workers' compensation claims, hospital discharge data and death certificates, to identify additional potential cases and to evaluate the completeness of reporting.

Between 1992 and 1996, the combined annual number of acute occupational pesticide-related illness and injury cases in California, New York, Texas and Oregon ranged from 775 to 1102. Most of these cases involved exposures to insecticides; among these, organophosphates and insecticide combinations were the most frequent. Slightly more than 50% of these cases involved agricultural exposures, including pesticide mixing, loading and application. Occupations involved in non-agricultural exposures included pesticide applicators and workers in offices or retail establishment working in proximity to areas where pesticides were applied or spilled.

Most of these state-based surveillance systems release an annual report on acute pesticide-related illness and injury, which can be obtained from the web page of the relevant program (Table 1 provides a listing of relevant websites).

National data collection and surveillance systems which include pesticide-related illnesses

The Toxic Exposure Surveillance System (TESS). - This system is maintained by the American Association of Poison Control Centers and collects poisoning reports submitted by approximately 85% of the poison control centers (PCC) in the United States [7]. Approximately 81% of the US population resides in a geographic area covered by a PCC. The TESS data are proprietary; however the data related to pesticides are purchased by the US Environmental Protection Agency (EPA) on an ongoing basis. TESS data are currently available for 1993 through 1998. Between 1993 and 1996, TESS identified 6,323 occupational pesticide-related illnesses, 63% of which were associated with insecticide exposures (principally organophosphates and pyrethrins/pyrethroids).

Bureau of Labor Statistics (BLS). - Since 1992 the BLS has provided annual estimates of the number of occupational pesticide-related illnesses and injuries that result in days away from work and that are recorded by employers, as required under the Occupational Safety and Health Act of 1970. These estimates are obtained through an annual survey of a scientifically selected probability sample of employers representing all private industry in the US. Between 1992 and 1996 national estimates of pesticide-related illnesses and injuries ranged from 504 to 914, mostly associated with exposure to insecticides. Because this system only captures cases that result in lost work time, the reported cases are more severe than those being reported to other surveillance systems. A note of caution should be taken with these estimates - because the number of identified cases is relatively small, and because the data are derived from a weighted sample, there is a potential for wide variability in the estimates across years. Printed reports are published annually, but are not specific for pesticide-related illness. Data are also available on the internet (Table 1).

Data collection and case classification

Data collection

One important function of a pesticide-related illness and injury surveillance system is to determine whether a pesticide exposure and subsequent health effects are related. To this end, data that are routinely collected include the date of the illness event, the age and gender of the involved person, the signs and symptoms of the illness, the name of the pesticide(s) involved in the exposure, and the circumstances surrounding the exposure including the route of exposure and whether the illness occurred as a result of workplace exposures. In the US, both TESS and the state-based programs collect these variables on each reported case, and in addition, information collected by the state agencies but not by TESS includes the race, occupation and industry of the ill individual, the activity of the individual when exposed, the location where the pesticide was applied, the type of exposure (e.g. drift, direct spray, contact with treated surface, indoor air contamination, or exposure to spill or leaking container), the use of personal protective equipment, and information on cholinesterase testing where indicated.

Table 1. - Useful web addresses of state-based acute pesticide-related illness surveillance programs and national pesticide databases *(*)*

Arizona	http://www.hs.state.az.us/edc/oeh/inv&surv.htm http://www.hs.state.az.us/edc/oeh/pestcide.htm
California	http://www.ohb.org/aginjury.htm#about_HESIS
Florida	http://www.doh.state.fl.us/environment/hsee/pesticides/default.html
New York	http://www.health.state.ny.us/index.htm http://www.health.state.ny.us/pesticid.htm
Oregon	http://www.ohd.hr.state.or.us/eoe/pest/welcome.htm
Texas	http://www.tdh.texas.gov/epidemiology/apps.html
Washington	http://www.doh.wa.gov/ehp/ts/pest.htm
NIOSH Bibliography - Chemicals/pesticides	http://www.cdc.gov/niosh/nasd/menus/nbib7.html
EPA Office of Prevention, Pesticides and Toxic Substances	http://www.epa.gov/opptsfrs/home/opptsim.htm
Bureau for Labor Statistics	http://stats.bls.gov/oshhome.htm
US Dept. of Agriculture Pesticide data program	http://www.ams.usda.gov/science/pdp/
Council for State and Territorial Epidemiologists	http://www.cste.org/ps1999/ENV3.doc

(*) updated December 12, 2000.

Case definition

When using or comparing data from various surveillance systems, it is important to understand the case definition that each system used. TESS, BLS and state-based surveillance systems each use a different case definition. Recently, the Council of State and Territorial Epidemiologists (CSTE) recommended use of a standardized case definition that was developed using a consensus process by a consortium of federal agencies (NIOSH, US EPA, National Center for Environmental Health), non-federal agencies (CSTE and the Association of Occupational and Environmental Clinics), and state health departments or other state designees [6].

The case definition requires the collection of information in three areas: pesticide exposure, health effects, and evidence supporting a causal relationship between exposure and effect. A case of pesticide-related illness or injury is classified as being either definite, probable, possible, or "suspicious". Individuals with health effects unrelated to pesticide exposures are classified as an "unlikely case". The specific classification category is chosen depending on the level of certainty of exposure, whether health effects were observed by a health care professional, and whether there is sufficient toxicologic information to support a causal relationship between the exposure and health effects. Cases are also classified as occupational or non-occupational. Occupationally-related cases are those in which the exposure occurred while the person was working (for example: working for compensation; in a family business, including a family farm; at home for pay; or as a volunteer Emergency Medical Technician (EMT), firefighter, or law enforcement officer). All other cases are classified as non-occupational, including suicide or attempted suicide. An abridged form of the case definition is available to the public (Table 1).

Severity determination

The American Association of Poison Control Centers has developed criteria for determining the severity of illnesses related to toxic exposure [7]. In summary, a minor effect consists of minimally bothersome health effects that generally resolved rapidly. A moderate effect consists of non-life threatening health effects that are more pronounced, prolonged or of a systemic nature compared to minor effects for which the affected person received some form of treatment. A severe effect consists of life threatening health effects or resulted in "significant residual disability or disfigurement" [7]. Of the state-based surveillance systems for pesticide-related illnesses, only Washington State uses similar criteria to

determine severity of the medical outcome; the other state agencies currently do not determine severity for the cases they identify.

Use of surveillance to identify emerging pesticide hazards and to promote the prevention of pesticide-related illnesses and injuries

Many cases of acute pesticide-related illness go unreported for a variety of reasons: the affected individual may not recognize the symptoms as pesticide-related and therefore not report the illness to the appropriate authorities; the affected individual may not seek health care for the symptoms; or the health care provider may misdiagnose the cause or diagnose it correctly but neglect to report it to the appropriate public health agency. It is because of this problem of under-reporting that the magnitude of pesticide-related illness and injury is difficult to determine. However, the state-based surveillance systems are well suited for identifying emerging pesticide hazards and new populations at risk. Collaboration with state agricultural agencies and poison control centers facilitates more complete case ascertainment, better case follow-up, detection of possible health effects previously unknown after exposure with certain products, identification of occupations not previously known to be at risk for pesticide-related illnesses, and implementation of multi-faceted prevention interventions [8, 9].

The development of appropriate prevention activities results from an accurate understanding of the circumstances of the poisoning event. There are two broad scenarios that explain most pesticide-related illness and injury events. The first involves events that are preventable by following precautionary measures specified on product labels and in government regulations. Appropriate interventions for these events include targeted educational campaigns on appropriate use of the product and enforcement of existing regulations. The second scenario includes events that occur despite compliance with label instructions and regulatory measures. For these events, appropriate interventions include changing pesticide use practices, and/or modifying regulatory measures. Examples of these two broad scenarios follow.

Example 1. In July 1998, 34 farm workers were poisoned after they entered a California cotton field that had been treated with carbofuran 2 hours earlier. All of these workers received medical treatment of symptoms and 28 of the workers lost at least one day of work. Carbofuran, when used on cotton, has a restricted entry interval of 48 hours and requires both posting of treated fields and oral notification of workers; however in this case neither warning was provided. This incident demonstrated that warnings are essential in preventing pesticide-related illness, and that failure to adhere to the restricted entry interval can result in unnecessary morbidity. This incident also suggests that the sole reliance on posted and oral warnings may be insufficient, and that substitution of less toxic pesticides should be adopted when feasible [10].

Example 2. Data from surveillance systems in three states (Washington, California and Texas) and from TESS were examined for incidents involving pet groomers. Forty-two illness cases were identified from exposure to products used to kill fleas. Among these were seven cases of chemical conjunctivitis caused by splashing of pyrethrin into the groomers' eyes. An information campaign was launched to inform pet groomers of the need to use personal protective equipment (including goggles designed to provide splash protection, and appropriate skin protection) when using flea killing substances, and the suggestion was made to substitute these products with those less toxic [11]. The pesticide label of pyrethrins does not require the use of eye protection.

Example 3. Several California grape harvesters became ill after exposure to phosalone-contaminated grapes. Although phosalone had been in use for nearly 20 years on crops that require minimal to moderate hand labor activity, poisoning events associated with this pesticide were not identified until it began to be used more widely on grapes, a crop requiring more extensive hand labor activity. This problem was detected when the ill grape harvesters were identified using surveillance data. These findings led directly to the withdrawal of this pesticide [12].

Example 4. A similar scenario was repeated in 1993 in Washington when 26 workers at 19 orchards became ill during a several month period after introduction of an organophosphate, mevinphos, which substituted the formerly used product taken off the market in 1992. Mevinphos had been safely used on field crops for years, and was used for the first time in 1993 on apples and pears, a labor-intensive crop involving close human contact with the trees. The outbreak and the ensuing investigation resulted in the withdrawl of mevinphos use in Washington apple and pear crops [12, 13].

These examples demonstrate the usefulness of integrated surveillance systems for pesticide-related illnesses and injuries both on the local and on the national level. The identification of mechanisms of exposure or situations in which the regulations for appropriate use are not respected or in which products in use may be excessively toxic serve to promote changes in practice or regulation with the objective of preventing further exposures to or illnesses from toxic pesticides.

Conclusions

While a comprehensive, national surveillance system for acute pesticide-related illness and injury does not currently exist in the US, each of the described surveil-

lance systems contributes in unique ways towards recognizing and preventing pesticide exposure and subsequent illness. Information obtained from the national Poison Control Database and the Bureau of Labor Statistics are useful for assessing magnitude and trends while the state-based surveillance systems are more useful for timely identification of outbreaks and emerging problems. Efforts are underway to increase the number of states that conduct surveillance and to broaden the use of the standardized case definition to facilitate aggregation of data across states. Through such efforts, a comprehensive, national surveillance system may be attainable.

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