RECOGNITION & ASSESSMENT OF PESTICIDE EXPOSURE

Acute organophosphate intoxications in children are frequently misdiagnosed, despite being linked closely in time with generally high pesticide exposures.[1,2] This reflects a number of factors:

- Symptoms of organophosphate toxicity are not pathognomonic, particularly in children.[3]
- Current medical education does not adequately prepare providers to have an index of suspicion regarding pesticide-related illness.
- Providers are not familiar with taking an environmental history as part of the overall clinical history.

EXPOSURE HISTORY TAKING

Evaluating exposures through specific questions helps establish the role of pesticides in both "sick visits" as well as routine primary care. During well child examinations, questions about pesticide use in and around the home, as well as at the child's school and parent's workplace, reveals the opportunity and appropriateness for anticipatory guidance on safe pesticide practices and prevention.

In agricultural areas, occupationally related exposures may be important not only for the worker but their household members due to residential proximity to treated fields, accessibility of pesticide chemicals, and work-to-home transfer of pesticide residues via skin, shoes, vehicles, and clothing.

It's important to remember that children themselves may be involved in work practices or workplaces where they encounter pesticides (e.g. harvesting, gardening, landscaping).

Examples of pesticide exposure history questions for agricultural workers and their families include:

- Does spraying go on while you are in the field?
- Do you feel sick while in the fields?
- Do your illness symptoms get better when you leave work at the end of the day (or over the weekend)?
- Were the fields wet when you were picking?

- Are you involved in the cholinesterase-monitoring program for pesticide handlers?
- Do your children play or work in the fields?
- Do you have lunch in the fields?
- Do you live in close proximity to the fields?
- Do you use pesticides in your home or yard/garden?
- Do you use any pesticide containers at home for anything other than holding pesticides?
- Does your child work in a place that involves contact with pesticides?
- Do you have pesticides stored at your house? If yes, are they stored within reach?

A pesticide exposure history from Rosa and her husband José reveals that José had brought home some leftover pesticide from his workplace. He applied it throughout their home the day before the baby had become ill in an effort to control a cockroach infestation in their apartment. He sprayed it around the baseboards throughout the home, including the room where the family sleeps.

What are the routes of exposure by which Isabella could have been exposed to this pesticide?

If pesticide exposure is to blame for Isabella's illness, why is she the only family member to have fallen ill?

EXPOSURE ROUTE AND DOSE

When the exposure history reveals pesticide exposure, consideration of the routes and extent of exposure can provide context for assessing whether the toxicity of the product, exposure scenario, and likely dose support the need for consideration of specific evaluation and treatment. In the setting of preventive care visits, the relevance of targeted anticipatory guidance can be determined.

Children's physiology and behavior increases the potential for exposures to pesticides that result in illness. Heightened vulnerability to pesticides may explain the pattern of illness seen in our case study, where only Isabella, the infant of the family, became symptomatic following household organophosphate exposure.

Three factors contributing to childhood pesticide vulnerability are discussed below:

A. Developmental toxicity
B. Routes of exposure
C. Patterns of exposure: behavior and sources

Developmental Toxicity

Childhood is unique from the perspective of ongoing development of organ systems. In particular, the nervous system is more vulnerable to organophosphate toxicity early in life because these pesticides disrupt processes critical to neuronal development.

Routes of Exposure

Organophosphate pesticides are readily absorbed across the skin, the lungs and the G.I. tract. Compared to adults, children experience a higher dose of pesticides through all of these routes.

Children may also experience metabolic vulnerability to pesticides as a result of the incomplete development and/or genetic variations in liver and kidney detoxification mechanisms.

Patterns of Exposure

In the case we have described, home use of a pesticide licensed exclusively for agricultural use resulted in an infant absorbing a harmful dose. This example highlights 1 of the 5 sources of childhood pesticide exposure. The complete list is as follows:

Sources of childhood pesticide exposure

1. Occupational exposure
2. Para-occupational or "take home" exposure
3. Home and school use of pesticide
4. Spray drift
5. Diet

Pesticide exposure patterns are largely determined by personal behaviors. Several behaviors unique to childhood increase a child's opportunity for excess exposure. The main factors to consider are:

Child-specific behaviors that elevate pesticide exposure

1. Time spent outside or near the ground
2. Mouthing behavior
3. Dependency on parents
4. Diet high in raw fruits and vegetables

Isabella's exposure to an OP pesticide in her home likely occurred via dermal absorption from her contact with residues on José 's skin and surfaces in the home, particularly the floor where cracks and crevices were treated. In addition, volatilization of the chlorpyrifos into the indoor air would result in exposure via inhalation. Her mobility on the floor (early crawling) would increase her opportunity to both encounter surface residues and inhale the highest air concentrations of pesticide in the room. Exposure via ingestion is likely from transfer of residues on her hands and other objects that she explores with her mouth, as is developmentally appropriate for her age.

PESTICIDE IDENTIFICATION

Brand names are a common way by which pesticides are identified. Unfortunately, brand names are not necessarily useful in determining active ingredients, as these names can change from year to year. In addition, manufacturers often use different brand names for different application uses of the same chemical. For example, home garden and agricultural insectides with the same active ingredient will be sold under two different brand names.

Pesticides can be classified in several ways. They are described by their "type", or intended use. Examples of pesticide type include insecticides, fungicides, herbicides, and rodenticides. These classifications have little toxicological significance, but are important to understand because consumers and manufacturers classify products in this way.

Pesticide Classes

Pesticides can also be grouped according to their chemical class. These are meaningful toxicological designations, because members of a class of pesticides share structural similarities that determine their mode of action. Thus, knowing the pesticide class aids in identifying acute health effects and appropriate treatment following pesticide poisoning. Unfortunately, information about pesticide class/family but may not be readily apparent from product name, label or usage category.

Pesticide Classes

- Organophosphates
- Carbamates
- Pyrethroids
- Triazines
- Superwarfarins

The EPA regulates pesticide product labels, requiring that all such labels contain certain information, including:

1. Type of pesticide.
2. Name, brand or trademark under which the product is sold.
3. Name & address of manufacturer/registrant.
4. List of active ingredients and their amount (%).
5. Signal words (DANGER/POISON, WARNING, or CAUTION).
6. Warning statements regarding precautions to be taken during use.
7. First aid statement for poisonings and spills.
8. Storage & disposal statements.

There are readily available resources that can help with identification of chemical class or toxicity based on active ingredients, including:

- The **Poison Control Center** network has access to databases that contain most product names and ingredients (1-800-222-1222)
- The **Material Safety Data Sheet (MSDS)** will contain a list of the ingredients that are considered hazardous to health. All manufacturers are required to produce these for their products. Employers are required to have an MSDS available for workers.
- The **National Pesticide Information Center** has technical pesticide information, including links to product, label and MSDS databases. They can be reached online or at 1-800-858-7378 9:30 am to 7:30 PM EST.
- The National Library of Medicine's Household Products Database provides a readily available interface to identify product ingredients based on product brand names.
- Many **state health departments** can provide information on pesticides.
- The **Pediatric Environmental Specialty Units (PEHSU)** are supported by the US EPA and CDC and provide **free telephone consultation** to physicians, public health professionals and the public. They are a useful resource for pesticide as well as other pediatric

environmental exposure concerns and questions. For region-specific toll-free phone numbers, see PEHSU.

- The **U.S. EPA's Handbook entitled "Recognition and Management of Pesticide Poisonings"** includes a table of numerous common brand names and generic chemical names in the organophosphate chapter. This is also an excellent resource that covers toxicology, signs and symptoms of poisoning, and treatment on the major types of pesticides. The most recent fifth edition (1999) is available in print or free online in Spanish and English.

You call the local poison control center and give them the product name ascertained in your exposure history. They inform you that an organophosphate pesticide is the active ingredient in this product.

The poison control center connects you with a clinical toxicologist affiliated with your regional PEHSU, who provides information on immediate diagnosis and treatment considerations. The toxicologist informs you that additional resources are available for this family at the State Department of Health's Program on Environmental Health.

Finally, you learn that a suspected pesticide poisoning is a reportable condition in your state (Washington) and are put in contact with the State's program for event reporting.

How should the clinical work up and management plans be modified based on your expanded exposure history information?