

# Clinical Manifestations of Pesticide Exposure Among Farmworkers

Resources for recognizing and differentiating  
possible pesticide toxicities

# Organization

- Presenters and Contributors
- Introduction to our project
- Review of pesticide exposure in farm workers and their families
  - Defining Pesticides
  - Types of exposure
  - Acute Toxicity
  - Chronic and Sub-acute Toxicity
  - Clinical Case studies
- Synthesizing Resources for your use
- Reporting Pesticide Exposures

# About the Presenters

- Amanda Byler, MSN, FNP-BC
  - Great Lakes Bay Health Centers – FQHC urban and migrant farmworker primary care
  - 4 years experience in current role
  - Interests include holistic, high-quality care of the underserved and international/cross cultural medicine
- Benjamin Gluck, M.S.
  - Third year Medical Student at Central Michigan University College of Medicine
  - B.S. & M.S. in Horticultural Science from Michigan State University
  - Interests include food and health, agriculture, social justice, primary care and emergency medicine

# Contributors

- Ben Phillips, MSU Extension
- Jiselly Salcedo, CMU COM
- Brittany Fields, CMU COM
- Hernan Lescay, CMU COM

Living the Dream













# Teamwork



**...THEREFORE, WE CAME  
TO THE CONCLUSION**

A photograph of two men standing behind a grey podium. The man on the left is wearing a white cowboy hat and a blue shirt. The man on the right is wearing a blue polo shirt and a dark cap. They are both looking down at the podium. The background is dark.

**WE NEED MORE TACOS**







If this doesn't work, the doc is coming next month

\*May not be FDA approved

# Challenges to Diagnosing Pesticide Exposure

- “Specialty” Practice
  - Rural
  - Agriculture/farm workers
  - Latino/minority/immigrant
    - Vulnerable population
    - Language barriers
    - Limited access or knowledge of healthcare
    - Cultural differences
  - Migratory
  - Social determinants of health

# Challenges to Diagnosing Pesticide Exposure

- Clinician Education
  - Intensive but very broad
  - Focus on most common or devastating disease states
  - Limited ability to focus on specialized topics in general practice
    - Residency or fellowship training
    - Experience
  - Lack of personal knowledge of agriculture/farm life
    - Have never done the work
    - Many don't know where our food comes from
    - Don't understand the use of pesticides in growing saleable produce



# Challenges to Diagnosing Pesticide Exposure

- Recognition of pesticide exposures
  - Providers
    - Don't include pesticide exposure as a differential
    - Non-specific symptoms
  - Patients
    - Unable to identify what they were exposed to (e.g., pesticide vs fertilizer)
    - Exposure to many chemicals and pesticides (e.g., pesticide drift)
    - May not recognize/know about exposure (e.g., use of residential pesticides)
    - Variable time to symptoms (e.g., lipophilic compounds)

# Challenges to Diagnosing Pesticide Exposure

- Practical Limitations
  - Diagnosing pesticide exposure
    - Non-specific symptoms
    - Inability to measure pesticide levels
    - Not knowing the probable pesticides exposed to
    - Effects of exposure may not be documented or researched
  - Treating pesticide exposure
    - Primarily symptomatic treatment
    - Few antidotes

# How This Project was Born

- Service Learning with Great Lakes Bay Health
  - Non-profit organization of Federally Qualified Health Centers
  - Started in 1969 as a small migrant clinic
  - Migrant program
    - Mobile Medical Unit
    - Seasonal health care center
- As part of the 1<sup>st</sup>/ 2<sup>nd</sup> year curriculum at CMU COM, students are required to do a service learning project with a local organization
- While working in the Great Lakes Bay Health Mobile Clinic, students learned that knowledge about pesticide exposure was a particular challenge for providers working with migrant farmworkers

# Project Goal

To create a resource that serves as a starting point for healthcare providers who want to know more about pesticide exposure in their patients

# What is a Pesticide?

- Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest.
- Any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.
- Any nitrogen stabilizer.

# Types of Pesticides

- Insecticides: protect crops from insect pests
- Fungicides: protect crops from fungal pathogens
- Herbicides: kill weeds that compete with crops
- Nematicides: kill nematodes
- Rodenticides: kill rodents/small animals
- Plant Growth Regulators: synthetic plant hormones and other chemicals that allow growers to manipulate plant physiology

# Exposure, Dose and Toxicity

- Exposure: amount of pesticide that a farmworker comes into contact with
- Dose: amount of pesticide that enters the body
  - “only the dose makes the poison”
  - Can be cumulative over extended time periods
- Toxicity: the extent to which something is poisonous or harmful



# Pesticide Exposure in Farmworkers and Their Families

## *Exposure Types*

- *Occupational*: direct exposure to pesticides while at work
- *Non-Occupational*: exposure outside of the working environment
  - *Paraoccupational (take-home)*: exposure of non-workers and workers due to residues that are carried home on clothing, boots, skin etc.
  - *Residential*: exposure to pesticides that are applied to housing to control insects and rodents
  - *Drift*: exposure to pesticides that are applied to nearby crops that drift in the wind

# Occupational Exposure

## *Exposure while at work*

- Latino farmworkers have higher levels of pesticide exposure than Latino non-farmworkers (1)
- Latino migrant farmworkers exposed to high pesticide levels in countries of origin (2)
  - May be pesticides that are no longer legal in the U.S.
  - May compound exposure risks
- Farmworkers are exposed to multiple pesticides multiple times a year (3)

# Non—Occupational Exposure

- More exposure to pesticides in agricultural areas and in the houses of farmworkers (4)
- Houses close to fields had higher pesticide concentration in the household dust (4)
- H-2A workers had higher residential exposure (1)
- AHS research has demonstrated spouses of pesticide applicators have increased health risks

# Pesticide Intoxication

## Acute vs. Sub-acute & Chronic

- Acute:
  - Timing: symptoms occurs immediately - within 24 hours of a single exposure
  - Severity: potential for loss of life, loss of vision, or permanent disability
- Sub-acute:
  - Timing: symptoms occurs within hours to days of exposure
  - Severity: no potential for loss of life, loss of vision, or permanent disability
    - Ex: delayed hypersensitivity dermatitis
- Chronic:
  - Timing: Sx occur after long periods of exposure (weeks/months/years)
  - Severity: may be mild (asthma) or result in serious debilitation (Parkinson Disease) or cancer

# Health Effects of Pesticide Exposure

## *Acute & Severe Intoxication*

- Much is known about the clinical presentation, pathophysiology, treatment and prognosis of acute intoxication to common pesticides relative to chronic and low level exposure
- When acute intoxication is suspected, the patient is immediately sent to the emergency department
- For example..

- You are working in a mobile clinic providing primary care when a 30 year old male presents to you with generalized weakness, vomiting, diarrhea, cough and difficulty breathing that began rapidly 30 minutes ago. His co-worker states that he spent the afternoon mixing and loading pesticides
- On physical exam he has pinpoint pupils, excessive salivation, coarse breath sounds, a heart rate of 40, and muscle fasciculations.
- What is the most likely diagnosis?
- What do you do next?

**Send this patient to the emergency department now!**

# Acute Intoxication with Organophosphate and/or Carbamate

- Pathophysiology: Well understood by most medical providers. These chemicals inhibit breakdown of the neurotransmitter acetylcholine, leading to hyperactivity of the parasympathetic nervous system
- Treatment: airway management, Atropine, Pralidoxime, seizure management, cardiac monitoring
- Prognosis: can be determined using one of several clinical scoring systems depending on the specific chemical
- Summary: In general, we know how to diagnose and treat acute exposure!



# Chronic & Sub-acute Exposure

- Compared to acute intoxication, relatively little is known about health effects, the clinical presentation or what to do about chronic and sub-acute pesticide exposure
- Unlike acute exposure, the effects of chronic exposure are more likely to be seen and managed by primary care providers

# Health Effects of Chronic Exposure

- Depression (12, 13)
- Fertility problems (2, 14)
- Asthma/wheezing/rhinitis (2, 15, 16, 17)
- Neurologic disorders/cognitive performance (e.g., Parkinson disease, slowed/altered cognitive testing) (2, 14, 8, 19, 20, 21)
- Pediatric neurodevelopment/behavioral disorders (ADHD, autism) (22)

# Cancer

- General cancer risk (2, 5, 6)
- Bladder cancer (7)
- Lung cancer (8)
- Liver cancer (9, 10)
- Non-Hodgkin Lymphoma (11)

# Research: Limitations

- Little research on chronic pesticide exposure
  - Little funding
  - Confounding factors
    - Exposure to multiple different chemicals, often repeatedly, over the course of a single growing season
    - Significant variation in type and amount of chemicals applied from one growing season to the next due to varying environmental conditions
  - Difficulty identifying effects over long periods of time
- Very little research on chronic pesticide exposure effects on migrant farmworkers

# Research: Limitations

- Difficulty measuring pesticide exposure
  - May only show in blood for a few hours
  - Most studies based on self-reports of exposure
- Most of the current research is from Agricultural Health Study
  - Same groups of people
  - Same crops and pesticide exposure
  - Results may not be generalize well

# Case Studies in Chronic and Sub-acute Pesticide exposure

# Case # 1

- About 6 women presented to the clinic within 2 months with numbness and tingling in the hands in Manchester, MI
  - Reasons to suspect pesticide exposure
    - All were working in the greenhouse
    - All were in their 20s
    - Farmer known for poor treatment of her workers
  - Reasons to suspect other mechanisms
    - New presentations were continuous over 2 months
    - Repetitive hand motions used in the work
    - First patient with complaints had received wrist splints
- No conclusion



## Case # 2

- Migrant, seasonal worker in mid-30s (landscape, tree service and handyman) in Saginaw, MI
  - Wheezing, cough and shortness of breath following cleaning mold from a basement with high concentration bleach
  - Company owner had the proper mask (respirator) but the foreman couldn't find it and gave him a paper mask instead
  - Had symptoms almost consistently for 2 years
- Clear pesticide exposure – this was reportable

## Case # 3

- Group of H-2A workers in Fowlerville, MI, presented complaining of a rash “from pesticides” while picking parsley
  - Presentation was uniform in presentation and timing
  - They were not wearing gloves provided
  - Rash was bothersome but no other symptoms
  - Symptoms seemed to worsen when the parsley was wet or damp

## Case # 3 Cont.

- Suspicious for possible pesticide exposure
  - Farmer is known for treating workers very well
  - No other symptoms were present
  - Rash was only areas that had been exposed to the plant
  - Rash was unusual



## Case # 3 Cont.

- Phytophotodermatitis
  - Chemical reaction causes hypersensitivity to UV light
  - Common culprits: Parsnip, parsley, celery, lime, lemon, carrot and the burning bush plant
  - Can be severe and skin discoloration could be permanent





## Case # 3 Cont.

- Follow up 1 month later
  - Started using a machine that was “spitting” parsley
  - Had been mostly using gloves but not the masks provided
  - Rash had worsened in exposed areas





# Case # 4

- Pregnant woman in California with symptoms after pesticide exposure from pruning grapes and pesticide drift from a nearby field (23)
  - Pesticides were identified because the date and time of exposure was known
  - One of the pesticides was teratogenic
  - Counseled on risks and options regarding pregnancy
  - Incident was reported to the Department of Environmental Health and the Office of the County Agricultural Commissioner

# Clinical Applications Summary

- Know common symptoms of pesticide exposure
- Know other common farm worker specific health issues (e.g., repetitive use of hands for cutting or picking, exposure to many plants)
- Know how to locate/perform a screening for occupational/environmental exposure (22)
- Recognize that non-occupational exposure may occur (specifically residential – house, garden, flowers)
- Know resources to help identify the most likely occupational pesticide exposure
- Know laws for reporting and agencies to report to in your state
- Encourage consistent, proper protective equipment

# Creating a Resource Manual

- Main objective: To create a resource that serves as a starting point for healthcare providers who want to know more about pesticide exposure in their patients
- Focused on identifying which chemicals farmworkers are most likely to be exposed based on the crops that a farmworker is working in

# Focusing on a Specific Population

- Farmworkers who are employed in the production of commonly grown vegetable crops in Michigan
- Does not include tree fruit, berry crops, ornamental and landscape plant production, tree farming, agronomic (row) crops

# Methods

- The vegetable crops included in our guide are those grown in Michigan for which pesticide use data was available through the United States Department of Agriculture National Agriculture Statistics Service (USDA NASS)
- The top three insecticides, fungicides, and herbicides by total pounds applied per year were included. When data were insufficient or unavailable, decisions were informed by other resources such as agricultural extension publications
- Our list was then edited for accuracy by Ben Philips, the MSU Extension vegetable crop production specialist for southeastern Michigan

# Methods

- Toxicological profiles for the most common herbicides, fungicides, and Insecticides used on each crop were compiled from the National Institutes of Health Toxicology Data Network (TOXNET), The Pesticide Action Network North America Pesticide Database, and the Extension Toxicology Network (EXTOXNET).
- These profiles consist of the chemical class and the most common clinical manifestations of Acute and sub-acute exposure.

# Results

- Commonly used pesticides were identified for 21 different vegetable crops grown in Michigan, including
  - Asparagus, Bell Peppers, Snap Beans, Broccoli, Cabbage, Carrots, Celery, Cucumbers, Eggplant, Garlic, Lettuce, Melon, Onion, Peas, Pumpkin, Spinach, Summer Squash, Strawberry, Sweet Corn, Tomato, and Watermelon
- Toxicological Profiles for 81 different chemicals were compiled
  - The amount of data available on each of these chemicals varied significantly
  - While detailed clinical pictures were available for some, others had no clinical data available for reference

## EGGPLANT / BERENJENA



### *Pesticides Used*

#### Herbicides

- Napropamide/Devrinol
- Paraquat (Gramoxone)
- Pendimethalin
- Trifluralin

#### Fungicides

- Azoxystrobin
- Chlorothalonil
- Copper Hydroxide
- Pyraclostrobin

#### Insecticides

- Oxamyl
- Esfenvalerate
- Imidacloprid
- Lambda-cyhalothrin
- Malathion
- Methomyl
- Permethrin



## ***Paraquat (Gramoxone)***

Chemical Class: Bipyridylum

Vegetables Used on: Bell Pepper, Cucumber, Eggplant, Watermelon

### ***Clinical Manifestations***

Eyes: severe irritation, damage, and blurred vision with direct contact.

Skin: irritation with direct contact, prolonged contact can lead to severe damage. Dry and fissured hands, horizontal ridging or loss of fingernails, ulceration.

Inhalation: sore nose and throat, nausea, and headaches.

Ingestion of low to moderate doses: burning, nausea, vomiting, abdominal pain and diarrhea Ingestion of higher doses: lesions may form in the mouth, throat, lung, and gastrointestinal tract. Decreased lung, kidney and liver function may occur, leading to multi-system failure and death.

# Limitations

- Does not include all crops vegetable crops that are grown in Michigan
- Does not include all chemicals used
- Many of the clinical manifestations are non-specific and overlap with the manifestations of intoxication with other chemicals
- The timing of pesticide application is not provided

# Resource Utilization

- [USDA NASS](#)
- [TOXNET](#)
- [Pesticide Action Network](#)
- [EXTOXNET](#)
- [UpToDate](#)

# Agricultural Extension

- Service run through land grant universities that disseminates and applies scientific research and new knowledge to agricultural practice through farmer/producer/grower education and consultation
- Extension agents typically specialize in specific group of crops and are assigned to a specific county or region of the state
  - Vegetables
  - Small fruits
  - Tree Fruits
- Extension agents are the most up to date on current agricultural practices, including which chemicals are being applied to which crops and when!
- Your local extension office and agent(s) may be the most important resource for gathering pertinent information about which pesticides your patients or clients are being exposed to

# Synthesizing Your Resources

- a) Gathering data pertinent to your patient/client's exposure
  - a) Which crop(s) are you working in?
  - b) What tasks are you performing?
    - a) Seeding, transplanting, weeding, harvesting, applying pesticides, packing
  - c) Record the date that these tasks were performed
- b) Consult your local extension office/agent and use web based resources to determine which chemicals your patients/clients are being exposed to based on the crop(s) they are working in
  - a) Specific chemicals are used at different times in the season. Only your local extension agent can help you reliably differentiate this.
- c) Use web based resources to find the clinical manifestations of exposure to a given chemical

# Practice Case

- 42 year old female farmworker comes to your clinic complaining of nausea, 3 episodes of vomiting, and a rash on her hands. The nausea started yesterday afternoon and she had three episodes of vomit (no blood/coffee grounds) overnight. She noticed the rash this morning. On ROS she also reports irritation of her eyes and nose. PEx is significant for a blistering rash on the dorsum of her hands bilaterally. What do we want to know next?
- Further questioning reveals that yesterday she spent the morning walking behind a tractor that was spraying pesticides. Her job was to hold a sheet of cardboard over the crop rows to protect the crops while pesticides were sprayed between the rows. She says that the crops she was protecting from the spray were cucumbers. When asked if she has ever experienced this before, she states that she did the same task last season but only experienced some nausea and eye irritation

# Practice Case

- What is the next step in our investigation?
  - Call your local extension office, get the vegetable specialist on the phone!
- You relay to the extension agent that you had a patient who yesterday was walking behind a tractor with a sheet of cardboard protecting cucumbers from a spray that appears to have been aimed between the rows. Based on this description, the agent informs you that the spray was most likely either Glyphosate, or Paraquat, both of which are broad spectrum herbicides used to kill weeds.

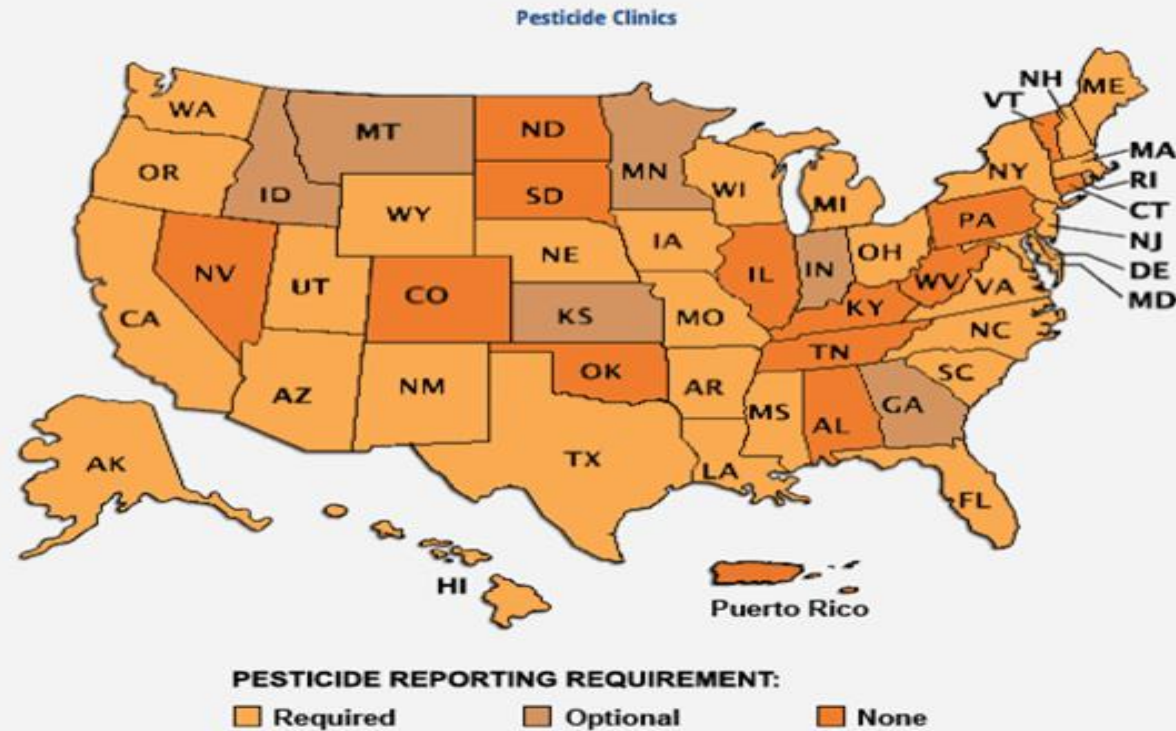
# Practice Case

- You then go back to the web, and, after reading through TOXNET, EXTOXNET, and/or UpToDate you conclude this was most likely due to exposure to Paraquat. Given the relative mildness of the symptoms, you determine that this was a small dose.
- You call to follow up on the patient and inform her of what you found. Fortunately, she is starting to feel better. Since she is improving, you decide to continue with symptomatic management and close follow up.
- Your decision to report this will depend on your state's reporting practices



# Reporting Pesticide Exposure

## Pesticide Reporting and Workers' Compensation in Agriculture - Interactive Map



<http://www.migrantclinician.org/issues/occupational-health/pesticides/reporting-illnesses.html>

# Reporting Pesticide Exposure

- Mandatory reporting in Michigan
- Reporting is typically to the state health department (e.g., Texas Dept of State Health Services)
- Michigan Dept of Health and Human Services (known or suspected chemical poisonings)
  - Oversees all chemical exposures
  - Can report directly to MDHHS by email, mail, phone, or fax
  - Report residential or home chemical exposure
  - Annual Occupational Pesticide Illness and Injury reports

# PESTICIDE EXPOSURE REPORT FORM



Michigan Law Requires the Reporting of Known or Suspected Chemical Poisoning.

(Under the HIPAA public health exception [section 1264.512 (b)] this reporting is exempt from "patient consent, authorization, or opportunity to agree or object.")

## Patient ID

\* Full Name: \_\_\_\_\_ \* Phone: \_\_\_\_\_ \* ☐ Male ☐ Female

Last First

\* DOB: \_\_\_\_\_ \* Occupation: \_\_\_\_\_ Employer: \_\_\_\_\_

\* Address: \_\_\_\_\_  
Street Address Apartment/Unit # City State ZIP Code

\* Pesticide Name: \_\_\_\_\_ \* Active Ingredient (if known): \_\_\_\_\_  
(Include phone picture)

EPA Registration Number: \_\_\_\_\_ \* Date of exposure: \_\_\_\_\_

## \* Reporting

Information reported to the Michigan Department of Health and Human Services (MDHHS) in accordance with the public health code is kept strictly confidential and is not subject to Freedom of Information (FOIA) requests. A patient release of information is not required in accordance with the HIPAA Public Health Exception for Obtaining Medical Records without Patient Consent, Authorization, or Opportunity to Agree or Object (Title 45 Public Welfare).

### Submit Report:

- ☐ Fax: 517-335-8509  
☐ Email: [schwartz@mdhhs.gov](mailto:schwartz@mdhhs.gov)  
☐ Mail: Abby Schwartz

Michigan Department of Health and Human Services  
Division of Environmental Health  
PO Box 30195  
Lansing, MI 48909

If you want to report this exposure for a regulatory investigation, you should contact the Michigan Department of Agriculture and Rural Development at 517-284-5639 as soon as possible. Be sure the patient saves any contaminated clothing for testing in a dark plastic bag.

## \* Provider ID

Provider/Reporter Name: \_\_\_\_\_ Date: \_\_\_\_\_

Address: \_\_\_\_\_ Phone: \_\_\_\_\_

Migrant Clinicians Network (2014). Adapted with permission from Mark Lyons, MPH, PAC, New Jersey Department of Health. Revised and reviewed by the MCN Environmental and Occupational Health Advisory Committee. This form may be adopted and duplicated as needed. Michigan revision 2017.

# Reporting Pesticide Exposures

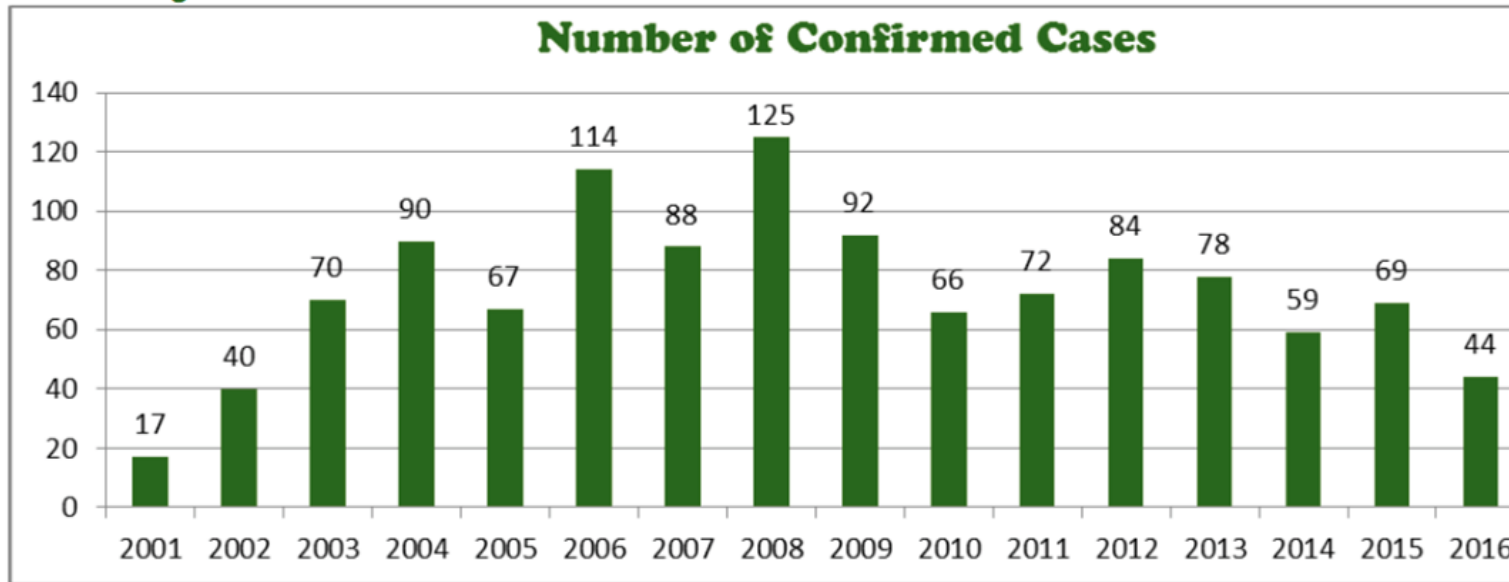
- Michigan State University Occupational and Environmental Medicine College
  - Reporting for occupational exposures
  - Can be reported online, by phone, fax, email, or mail
  - Reports are shared with the Michigan Dept of Health and Human Services

# Reporting Pesticide Exposures

**Michigan State University & Michigan Department of Health and Human Services**

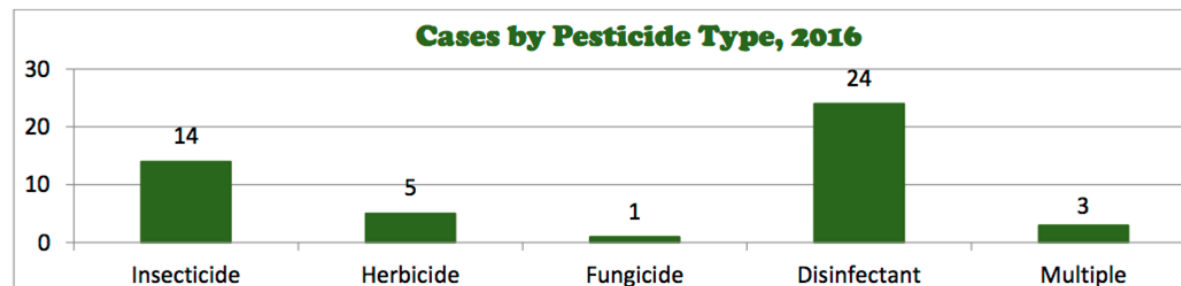
## **Occupational Pesticide-related Illnesses and Injuries in Michigan, 2016**

### **Summary Statistics**

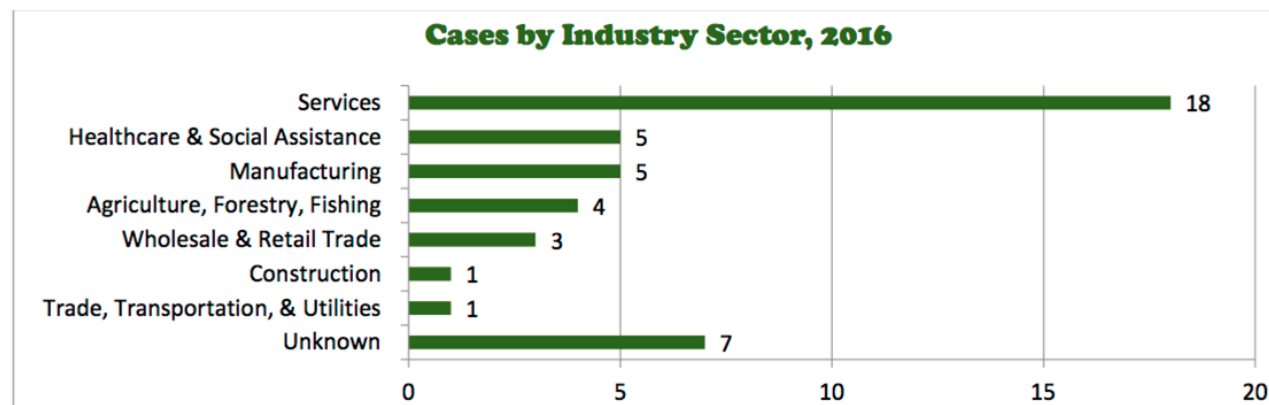


Taken from: [http://www.michigan.gov/documents/mdhhs/2016\\_Occupational\\_Illness\\_and\\_Injury\\_Fact\\_Sheet\\_563112\\_7.pdf](http://www.michigan.gov/documents/mdhhs/2016_Occupational_Illness_and_Injury_Fact_Sheet_563112_7.pdf)

# Reporting Pesticide Exposure



\*Multiple means one product had more than one type of pesticide. A case could also be exposed to more than one product.



The "Services" sector includes "Services to Buildings and Dwellings", such as structural pest control or landscaping, as well as "Accommodation and Food Services" such as hotels and restaurants, where many disinfectant exposures occurred.

# Summary

- Pesticide exposure is nearly universal and continuous in farmworkers and their families
- The effects of sub-acute and chronic toxicity are poorly understood and documented
  - Be aware of pesticide toxicity as a differential diagnosis
  - Be aware of confounding factors such as plant oils and mechanical risks from repetitive work
- Resources for better understanding pesticide application, exposure risk, and agricultural practices do exist and can be extremely helpful
  - Know your local agricultural extension office/agent
  - Know where to find more information on symptoms of possible pesticide exposure (EPA, National Pesticide Information Center, etc)
- Taking a thorough history in farmworkers includes occupational questions
- Reporting pesticide exposure may be a mandatory in your state

# Resources

- [National Pesticide Information Center](#)
- [Environmental Protection Agency](#)
- [Migrant Clinicians' Network](#)



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