


**The Nuts and Bolts of Cholinesterase Monitoring for Farmers, Ranchers and Agricultural Workers**  
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### *Disclosure Statement*

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**Disclosure:** We have no real or perceived vested interests that relate to this presentation nor do we have any relationships with pharmaceutical companies, biomedical device manufacturers, and/or other corporations whose products or services are related to pertinent therapeutic areas

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### Objectives

1. Assess the human health importance of cholinesterase screening.
2. Identify which types of pesticides require cholinesterase screening and the people most likely to be exposed to those pesticides.
3. Analyze screening protocols including baseline testing, laboratory specifics, and follow up for applicability to clinic sites.
4. Evaluate appropriate testing and follow up for acute exposures.
5. Discuss roles and responsibilities of providers in screening, prevention, treatment and follow-up of pesticide exposures.



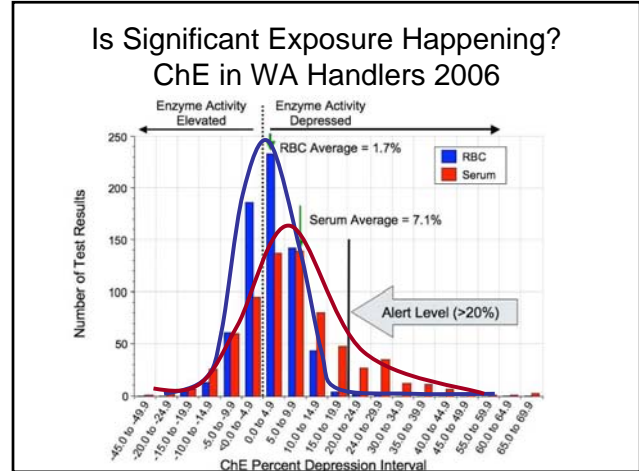

Presented by Matthew Kiefer, MD, MPH and Carolyn Sheridan, RN, BSN. Developed by AgriSafe Network, National Farm Medicine Center, and Migrant Clinicians Network.



### Cholinesterase in Washington State

One BIG state-wide experiment

- Cholinesterase (ChE) monitoring since 2004
- Applicators of class 1 & 2 Organophosphates (OPs) and carbamates
- >30 hrs in 30 days


### Benefits of Che Monitoring

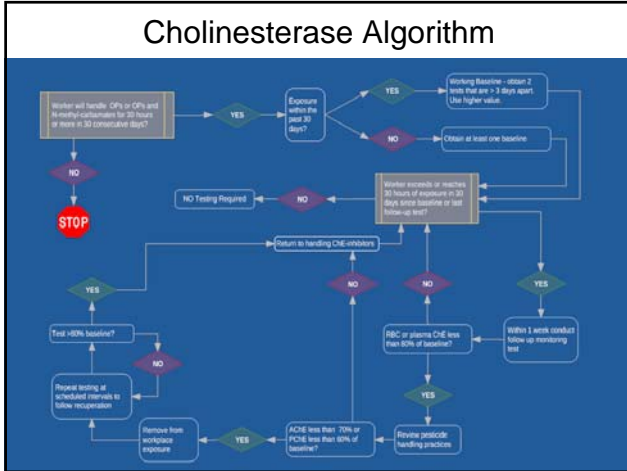
- Remove overexposed workers before illness begins
- Identify failures in worker protection
- Raise awareness of hazards of chemicals monitored
- Diagnose acute overexposure
- Drives the financial equation toward safer chemicals

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### Cholinesterase Protocol for Healthcare Providers

- Whom to Test?
- Testing
- Post Exposure Testing
- Medical Removal
- Level of Return to Handling
- Review of Handling Practices






### Pesticide Exposure Health Risk

- Some of the most toxic pesticides are insecticides
- Some of the most toxic insecticides are cholinesterase inhibitors (LD<sub>50</sub> 0.5 -1000 mg/kg)
- Organophosphates (OP) and N-methyl – carbamates are the insecticidal cholinesterase inhibitors

### Organophosphates: Born of A Bad Seed

- OPs and carbamates inhibit cholinesterase
- Toxicity is similar but OPs have longer inhibitory persistence
- OPs found to be in Nazi Germany
- Tabun, Sarin, Cyclosarin and Soman are their homicidal sibs

**Dr. Gerhard Schrader**  
Der Erfinder des Schädigungskämpfungsmittels 8.604

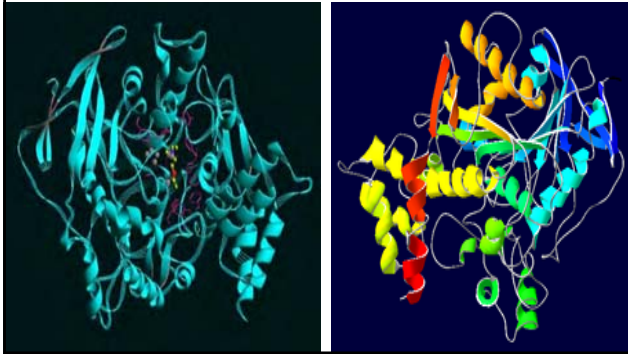


Wendeholzer Heimatkalender Nr. 14

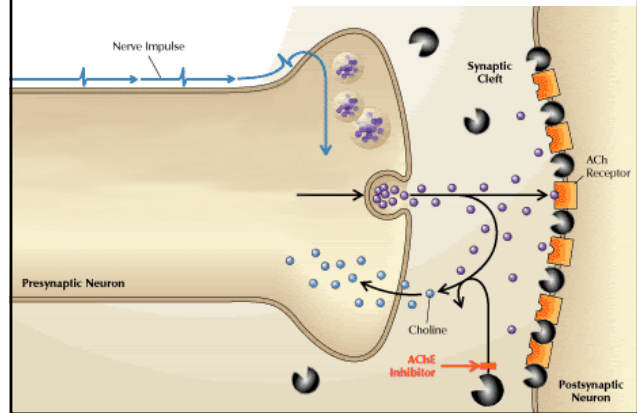
### Route and Toxicity Oral vs. Dermal LD<sub>50</sub> of some OPs

| Organophosphate     | Oral       | Dermal     | Dermal/<br>Oral |
|---------------------|------------|------------|-----------------|
| Phorate             | 2 mg/kg    | 6 mg/kg    | 3               |
| Azinphos-Methyl     | 13 mg/kg   | 220 mg/kg  | 17              |
| Methamidaphos (rat) | 32 mg/kg   | 94 mg/kg   | 3               |
| Oxydemeton (rat)    | 75 mg/kg   | 250 mg/kg  | 3               |
| Diazinon (rat)      | 108 mg/kg  | 900 mg/kg  | 9               |
| Phosalone (rat)     | 130 mg/kg  | 1500 mg/kg | 12              |
| Chlorpyrifos (rat)  | 155 mg/kg  | 202 mg/kg  | 1.3             |
| Malathion (rat)     | 1375 mg/kg | 4444 mg/kg | 3               |
| Aldecarb (rat)      | 0.5mg/kg   | 3.5 mg/kg  | 3               |

### Plasma and Acetyl cholinesterase



### What is Cholinesterase?



### Toxicity of Cholinesterase Inhibitors Organophosphates /Carbamates

#### Muscarinic SxS

- Miosis
- Diaphoresis
- Salivation
- Lacrimation
- Urination
- Defecation
- Gastroenteric cramping
- Emesis

#### Nicotinic SxS

- Diaphoresis
- Salivation
- Headaches
- Weakness
- Nausea
- Resp Paralysis
- Fasciculations

### Miosis: a characteristic of OP and Carbamate poisoning



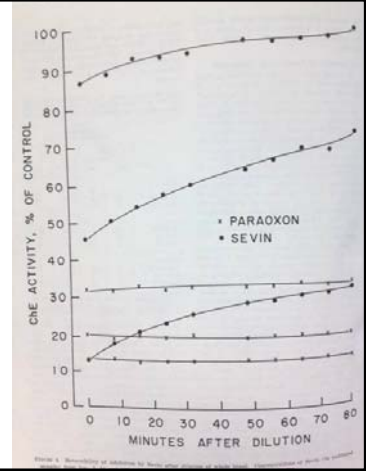
### Who to Monitor?

- Individuals who **apply** Class I or II Organophosphate pesticides or Organophosphates and N-methyl-Carbamates
- Working 30 or more hours within any 30-day period



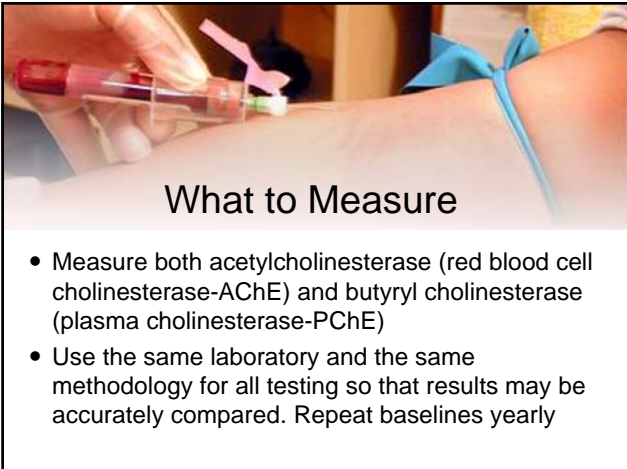
### Why not Carbamates?

Work by  
Fowler P and  
Mckenzie J.  
1967



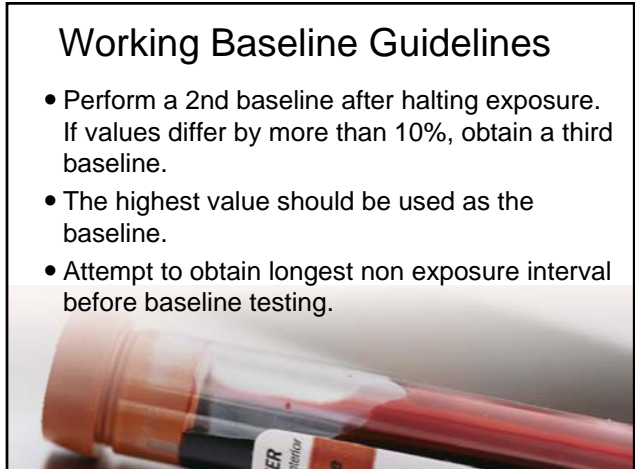
### What to Measure

- Measure both acetylcholinesterase (red blood cell cholinesterase-AChE) and butyryl cholinesterase (plasma cholinesterase-PChE)
- Use the same laboratory and the same methodology for all testing so that results may be accurately compared. Repeat baselines yearly



### Working Baseline Guidelines

- Perform a 2nd baseline after halting exposure. If values differ by more than 10%, obtain a third baseline.
- The highest value should be used as the baseline.
- Attempt to obtain longest non exposure interval before baseline testing.



### AChE versus PChE

- Red blood cell turnover is slow (about 3 months)
  - AChE measurements reflect this slow replacement rate.  
 $100/120 = 0.83\%$  recovery per day
- PChE turnover is quicker. Estimates are about 1.2% recovery per day
  - PChE is more sensitive to certain organophosphates.
- Obtain a baseline reading of both measures during the non-exposed period, at least 30 days since the last exposure to OP pesticides. Two baseline values ideal. Average the values.

### Post Exposure Testing Guidelines

- Ideal: Test within 3 days of any 30-day period in which individual has met or exceeded handling hours threshold.
- Compare each reading to individual's baseline and calculate per cent of activity relative to baseline.
- $\% \text{ act.} = \text{BL act} - \text{PE act} / \text{BL act} \times 100$

### Action Levels

- Evaluate Work Place
  - >20% decrease from baseline in AChE or PChE = Evaluate work practices
- Medical Removal
  - >30% decrease in AChE or
  - >40% decrease in PChE
  - Remove worker from exposure to OPs and carbamates until levels return to within 80% of baseline




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### Return to Work

- Level to Return to Work
  - Return to work when test result is greater than or equal to 80% of baseline.
- Retest for Return to Work
  - Days to repeat test is determined by degree of ChE activity reduction.
  - RBC:  $(\% \text{ depression} - 20) / 0.83$   
= # of days to repeat test
  - plasma:  $(\% \text{ depression} - 20) / 1.2$   
= # of days to repeat test






### Review Work Practices

- Review work practices when test result is less than 80% of baseline.
  - Reading and understanding label
  - Use of personal protective equipment
  - Pesticide handling practices
  - Precautions taken with chemical spills
  - Reporting symptoms
  - Reporting exposures

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### Role of Clinician

- Monitor Cholinesterase levels
- Understand signs and symptoms
- Review protective measures with patient
- Review protective measures with employer
- Report
- Remember – No need to be an expert
  - Plenty of resources!



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### MCN's Environmental and Occupational Health Program

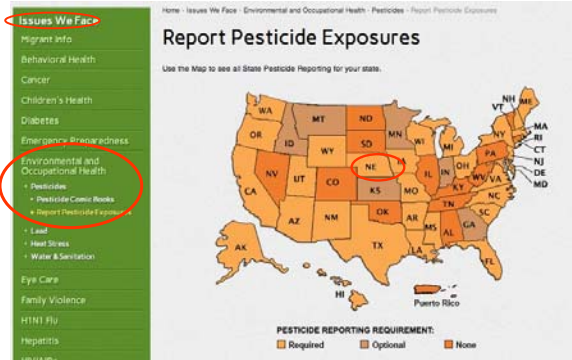
SIMPLE, Flexible, Effective

- Partnerships with Health Centers
- Practical Training for Primary Care Providers
- Resources
- Connecting Primary Care to Occupational and Environmental Medicine
- Technical Assistance

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### MCN's Pesticide Exposure Reporting Map

[www.migrantclinician.org](http://www.migrantclinician.org)



Home - Issues We Face - Environmental and Occupational Health - Pesticides - Report Pesticide Exposures

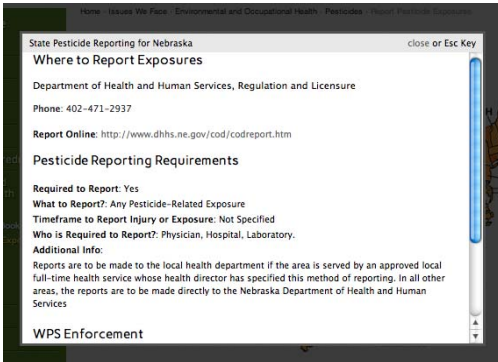
#### Report Pesticide Exposures

Use the Map to see all State Pesticide Reporting for your state.

PESTICIDE REPORTING REQUIREMENT:  
■ Required ■ Optional ■ None

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## Pesticide Reporting Information



## EPA Worker Protection Standard

Regulation aimed at reducing the risk of pesticides and injuries among agricultural workers and pesticide handlers.

- Contains requirements for:
  - pesticide safety training
  - notification of pesticide applications
  - use of PPE
  - restricted entry after pesticide application
  - decontamination supplies
  - emergency medical assistance



Information available at [www.epa.gov](http://www.epa.gov)

## Prevent Exposure



## Education

- Read the Label
  - Look for "precautionary statement" which describes how poisonous the product is and how to best protect yourself
  - Use of Restricted Pesticides requires specialized training and certification
- Partner with organization offering the Pesticide Applicator Training





## Personal Protective Equipment

### Head to Toe Protection



## Reduce Chemical Risk

- Wear head protection – waterproof disposable hood or plastic wide brim hat
- Wear unlined, chemical resistant gloves (neoprene and nitrile are best) – *do not wear cotton or leather*
- Chemical resistant aprons
- Unlined rubber neoprene or PVC boots or shoes willing to discard
- Wear eye protection – goggles with indirect vent and fog-free lenses
- Disposable coveralls such as Tyvex or long sleeved shirts and pants
- If label says wear a respirator – wear one



OSHA Standards: Agriculture Standards 29CFR1928 and General Industry 29CFR 1910.132-139

## Employee Rights and Responsibilities



You have the right to:

- A safe and healthful workplace
- Know about hazardous chemicals
- Information about injuries and illnesses in your workplace
- Complain or request hazard correction from employer

## Employee Rights and Responsibilities

You have the right to:

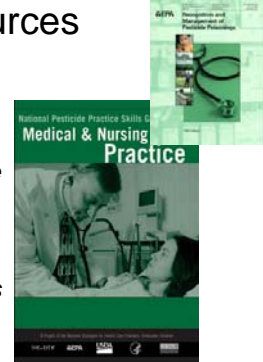
- Training
- Hazard exposure and medical records
- File a complaint with OSHA
- Participate in an OSHA inspection
- Be free from retaliation for exercising safety and health rights

### Employee Rights and Responsibilities

- OSHA website: [www.osha.gov](http://www.osha.gov) and OSHA offices: Call or Write (800-321-OSHA)
- Compliance Assistance Specialists in the area offices
- National Institute for Occupational Safety and Health (NIOSH) – OSHA’s sister agency
- OSHA Training Institute Education Centers
- Doctors, nurses, other health care providers
- Public libraries
- Other local, community-based resources

### Resources

- ChE Protocol
- ChE Algorithm
- EPA's *Recognition and Management of Pesticide Poisonings*
- *Handbook of Pesticide Toxicology*, 1991
- EPA *Pesticide Guidelines*
- [www.epa.gov/pesticides/](http://www.epa.gov/pesticides/)
- [www.osha.gov](http://www.osha.gov)



All Resources: [www.migrantclinician.org/nutsandboltsresources](http://www.migrantclinician.org/nutsandboltsresources)

### Contact Information

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- Thank you!



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