Washington State Department of
Labor & Industries

Cholinesterase Monitoring of Pesticide Handlers in Agriculture: 2014 Report

Division of Occupational Safety and Health (DOSH)

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2014 Summary of the Labor and Industries Cholinesterase Monitoring Program

The Division of Occupational Safety and Health (DOSH) administer an agriculture worker blood cholinesterase monitoring program under WAC 296-307-148[1], Cholinesterase Monitoring. During the 2014 cholinesterase monitoring season (January – September), ~364 growing operations and 2232 pesticide handlers participated in baseline cholinesterase testing. Two hundred and twenty four of these pesticide handlers were tested again (periodic testing) at least once during the pesticide application season. The great majority of handlers submitting periodic tests met the testing requirement threshold of handling toxicity class I or II organophosphate or N-methyl-carbamate pesticides for ≥30 hours in any consecutive 30 day period. However, in some cases employers scheduled testing regardless of number of handling hours.

Of these 224 handlers, 15 (7.0%) received at least one test indicating a cholinesterase activity depression of >20% (action level) requiring the employer to evaluate pesticide handling practices. There were eight action level cholinesterase depressions requiring temporary removal from handling organophosphate and n-methyl carbamate pesticides. All action level cholinesterase depressions occurred in Labor & Industries (L&I) Region 5[2]. Five growing operations (all separate employers) accounted for the 8 action level cholinesterase depressions.

The number of pesticide handlers establishing baselines in 2014 increased decreased from 2013 (2091 vs. 2232), while the number of handlers undergoing periodic testing remained relatively stable. Yearly testing numbers are believed to be affected by variations in factors including, but not limited to:

a) Pest control strategies
b) Use of class I and II cholinesterase inhibiting pesticides
c) Employer actions resulting in limiting handler exposure (e.g., employee rotation).

All handlers with cholinesterase depressions at the action level were employed in the tree fruit industry and characterized as mixer/loader/applicators. DOSH worksite field evaluations of action level cholinesterase depressions identified multiple Pesticide Worker Protection Standard violations that may have contributed to over-exposure including, but not limited to, training, respiratory protection, and personal protective equipment requirements. Toxicity class I and II cholinesterase inhibiting pesticides handled within the 30 days prior to periodic testing included Phosmet, Carbaryl, and Chlorpyrifos.

Pathology Associates Medical Laboratories (PAML) continues to conduct all laboratory analyses. Quality control indicators were well within limits and customer satisfaction remains high. PAML will continue to serve as the sole laboratory approved by DOSH in 2015.

In conclusion, the 2014 cholinesterase monitoring program functioned as designed. The program continues to provide value by maintaining awareness of hazardous chemicals and worker protections, and bolsters DOSH's ability to work directly with agriculture employers to solidify pesticide worker protection programs.

[1] http://www.lni.wa.gov/WISHA/Rules/agriculture/HTML/part-j-1.htm
[2] http://www.lni.wa.gov/Safety/Basics/Assistance/Consultation/consultants.asp

Background

Acetylcholinesterase (AChE) is an enzyme that removes the chemical neurotransmitter acetylcholine from the junctions between nerve cells. AChE effectively serves as the nerve cell "off switch" and is essential to normal nervous system function. Certain pesticides, known as cholinesterase inhibitors, bind with AChE resulting in over-excitement of nervous system pathways.

Exposure to organophosphate or N-methyl-carbamate pesticides may lower the level of active cholinesterase in the nervous system. Depressed cholinesterase activity may lead to physical symptoms ranging from malaise, blurred vision, and diarrhea, and in extreme cases, coma and death. Laboratory monitoring of cholinesterase levels in the blood (both serum and red blood cell [RBC] cholinesterase) detects reductions in cholinesterase activity prior to the onset of symptoms (pesticide illness), as well as provides information regarding pesticide exposure and the effectiveness of exposure control measures. Cholinesterase levels may be affected by such factors as liver and blood disease, and certain medications; in the absence of such factors, cholinesterase depression is most likely caused by over-exposure to the cholinesterase inhibiting pesticides handled by the these workers. Previous reports provide detailed background and describe cholinesterase monitoring experiences during the years 2004 through 2010[3].

WAC 296-307-148, Cholinesterase Monitoring (the rule), was adopted in December 2003 and has remained unchanged after amendments were made in 2005. The rule requires agriculture employers to: a) record hours employees handle[4] toxicity class I and II organophosphate and N-methyl-carbamate pesticides (covered pesticides); b) provide cholinesterase blood testing to employees who handle covered pesticides for 30 or more hours in any consecutive 30 day period; and c) follow health care provider recommendations regarding pesticide handling practices and medical evaluation. A copy of the licensed health care provider's (LHCP) written recommendation is provided to the handler by the employer. Health care provider recommendations include verification of testing, actions to be taken based on cholinesterase activity, and any recommendations regarding further medical evaluation.

DOSH offers consultation services to agriculture employers with pesticide handlers who experience a cholinesterase depression >20% (action level cholinesterase depression). In addition to assisting with an evaluation of the employer's pesticide worker protection program and the pesticide handler's work practices, information on pesticide handling practices and equipment is gathered. DOSH compliance inspections are opened in certain circumstances such as clusters of action level cholinesterase depressions, and employer refusal to accept consultation services.

DOSH continued to provide reimbursement to employers for testing services and related administrative program costs[5]. Approximately forty to forty-five employers requested and were granted reimbursements totaling approximately $115,000.

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[3] Previous reports can be found at by request through the follow website http://www.lni.wa.gov/Safety/Topics/AtoZ/Cholinesterase/default.asp

[4] Pesticide handling is defined in WAC 296-307-11005

[5] The Cholinesterase Monitoring reimbursement request form can be found at http://www.lni.wa.gov/forms/pdf/413062af.pdf

The following table outlines participation and monitoring outcomes for the years 2009-2014 of the cholinesterase monitoring program.

	2009	2010	2011	2012	2013	2014
# growing operations*	217	315	388	307	328	364
# Handlers submitting baseline tests	2056	1989	2017	2091	1994	2232
# Handlers declining testing	229	Data not collected	Data not collected	Data not collected	Data not collected	Data not collected
# Working baselines	29	51	43	47	44	51
# Handlers with ≥1 periodic test	249	257	186	148	130	127
# Periodic tests	286	316	202	216	226	224
# Handlers with ChE depression to work evaluation level	15(6.1%)	8(3.1%)	6(3.2%)	13 (6.0%)	4(2.0%)	7(3.0%)
# Handlers with ChE depression to exposure removal level	7(2.8%)	0	0	5(2.3%)	9(4.0%)	8(4.0%)
Total # handlers with AL ChE depression	22(8.8%)	8(3.1%)	6(3.2%)	18 (8.3%)	13(6.0%)	15(7.0%) **
# Handlers reporting pesticide illness symptoms	0	0	0	0	0	0

*A growing operation is defined as a specific site or orchard. An employer may have multiple growing operations
**3 serum and 12 RBC cholinesterase depressions

Medical Services

Sixteen medical clinics provided blood collection and medical evaluation services. Thirteen clinics are located in Region 5, and three in Region 1[6]. In preparation for the 2014 monitoring season, DOSH contacted all participating clinics and provided guidance with the rule and

[6] http://www.lni.wa.gov/Main/FindAJob/regions.asp?WT.svl=3

cholinesterase medical monitoring guidelines. All clinics reported satisfaction with the laboratory services and support provided by DOSH.

PAML in Spokane is the sole laboratory approved to provide testing services. There were no changes in Standard Operating Procedures[7] from 2013 to 2014. Blood samples are packed in ice and picked up at the clinic using same-day courier services. Samples are analyzed within 24 hours of collection and reported to both the clinic and DOSH that same day.

PAML is required to provide evidence of a robust quality assurance program including but not limited to:

- Maintaining a written quality assurance plan.
- Participation in the College of American Pathologists serum cholinesterase proficiency testing program.
- Allowing independent review of quality assurance data.
- Demonstration of proficiency through analysis of blinded samples.

The DOSH industrial hygiene laboratory regularly reviews PAML quality control reports and conducts onsite visits. All quality control indicators demonstrated good precision throughout the season.

Monitoring Summary

As in previous years, the vast majority of employers participating in the cholinesterase monitoring program had operations located in Central Washington (West Adams, Benton, Chelan, Columbia, Douglas, Franklin, Grant, Kittitas, Okanogan, Walla Walla, and Yakima counties). North and Southwest Washington counties accounted for the remainder of the samples submitted.

During the 2014 cholinesterase testing season (January – September), ~364 growing operations participated in testing and 2232 handlers submitted cholinesterase baseline samples, with baseline submissions increasing from 2013 (1994).

Of the 224 pesticide handlers who received at least one periodic test, 7 (3.0%) received a periodic test result having a >20 percent cholinesterase activity depression from baseline (action level cholinesterase depression) requiring the employer to evaluate handling practices for possible deficiencies. 8(4.0%) handlers experienced cholinesterase depression levels requiring temporary removal from handling organophosphate and N-methyl-carbamate pesticides a serum cholinesterase depression of $\geq$40% or RBC cholinesterase depression of $\geq$30%). The 15 handlers (2 serum and 13 RBC action level cholinesterase depression) worked for six different growing operations.

L&I Consultation and Compliance Findings

During either a consultation or compliance visit all depression was associated with personal protective equipment use. In general respirator fit testing, donning and doffing equipment are issues employer and employees continue to face.

[7] Available upon request

Conclusion

In conclusion, the 2014 cholinesterase monitoring program functioned well. The 15 action level cholinesterase depressions identified represent similar trend in amount of depression for the previous year. While it is not possible to identify definitive reasons for the continuing trend in action level cholinesterase depressions, the sustained awareness of pesticide hazards and protections and feedback loop that monitoring provides, are certainly factors in maintaining low level depression events. .

Laboratory testing is conducted in accordance with Standard Operating Procedures finalized in 2009. Quality control parameters for both serum and RBC cholinesterase testing remain within acceptable limits. PAML will continue to be the sole laboratory providing testing services through 2015.