



Cholinesterase Monitoring of Pesticide Handlers in Agriculture: 2009 Report

Division of Occupational Safety and Health (DOSH)

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Executive Summary

The Division of Occupational Safety and Health (DOSH) administers the agriculture cholinesterase monitoring program under WAC 296-307-148¹, Cholinesterase Monitoring (the rule). During the 2009 cholinesterase monitoring season (January 12 – September 17), ~217 growing operations and 2060 pesticide handlers participated in baseline cholinesterase testing. Two hundred and forty nine of these pesticide handlers were tested again (periodic testing) at least once during the 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 249 handlers, 22 (8.8%) received at least one test with a serum cholinesterase activity depression of $>20\%$ (action level) requiring the employer to evaluate pesticide handling practices, there were no red blood cell cholinesterase action level depressions. Seven (2.8%) of the 22 handlers were temporarily removed from exposure to covered pesticides because of a serum cholinesterase depression of $\geq 40\%$. All action level cholinesterase depressions occurred in Labor & Industries (L&I) Region 5². Twelve growing operations accounted for the 22 action level cholinesterase depressions.

The number of pesticide handlers undergoing blood cholinesterase testing in 2009 rose slightly from 2008 (2013), while the number of participating growing operations remained unchanged. However the number of handlers undergoing periodic testing decreased from 314. This is believed to be affected by actions such as; a) changes in pest control strategies, b) reductions in Guthion use, and c) employer actions resulting in limiting handler exposure (e.g., employee rotation).

All handlers with cholinesterase depression to the action level were employed in the tree fruit industry (DOSH is not aware of any field crop operations participating in the cholinesterase monitoring program) and all operations applied pesticides through the air blast method. DOSH consultation and compliance field evaluations identified common potential over-exposure scenarios involving respiratory protection, personal protective equipment and decontamination. Toxicity class I and II cholinesterase inhibiting pesticides handled within the 30 days prior to periodic testing included Lorsban, Guthion, Imidan, Phosmet, Carbaryl, and Carzol (Sevin 4F and Diazinon 50W Class III pesticides were also used).

Pathology Associates Medical Laboratories (PAML) continues to conduct all laboratory analysis. 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 2010.

In conclusion, the 2009 cholinesterase monitoring program functioned well. The information gleaned from field evaluations is used by DOSH and WSDA in developing pesticide handler training curriculum. 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 nerves 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 available cholinesterase in the nervous system. Depressed cholinesterase activity may lead to symptoms ranging from malaise, blurred vision, and diarrhea to, 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 related symptoms, as well as provides information regarding pesticide exposure and the effectiveness of exposure control measures. While 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 – 08³.

WAC 296-307-148, Cholinesterase Monitoring (the rule), was adopted in December 2003 and remains unchanged since amendments were made in 2005. The rule requires agriculture employers to: a) record hours employees handle⁴ 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 for pesticide handlers 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 cholinesterase percent change from baseline, direction regarding actions to be taken based on cholinesterase activity, and any additional direction regarding further medical evaluation.

DOSH offers consultation services to agriculture employers with pesticide handlers who experience a cholinesterase depression >20% from individual baseline (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 services⁵.

Reimbursement to employers for testing services and related administrative program costs

³ Previous reports can be found at <http://www.lni.wa.gov/Safety/Topics/AtoZ/Cholinesterase/default.asp>

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

⁵ DOSH Directive 33.27 Cholinesterase Depression
<http://www.lni.wa.gov/Safety/Rules/Policies/PDFs/WRD3327.pdf>

continued in 2009. Sixty-one employers requested and were granted reimbursements totaling \$129,000.00.

The following table outlines participation and monitoring outcomes from the inception of the cholinesterase monitoring program.

Washington State Agriculture Cholinesterase (ChE) Monitoring 2004-09						
	2004	2005	2006	2007	2008	2009
# Employers	380	316	244	226	218	217
# Handlers submitting baseline tests	2630	2263	1889	1857	2013	2060
# Handlers declining testing*	Data not collected	232	184	167	192	229
# Working baselines	Data not collected	165	48	120	71	29
# Handlers with ≥ 1 periodic test	580	611	471	386	314	249
# Periodic tests	911	970	692	532	495	286
# Handlers with ChE depression to work evaluation level	97(16.7%)	49(8.0%)	50(10.6%)	49(12.6%)	21(6.7%)	15(6.1%)
# Handlers with ChE depression to exposure removal level	22(3.8%)	10(1.6%)	7(1.5%)	18(4.6%)	1(0.1%)	7(2.8%)
Total # handlers with AL ChE depression	119(20.5%)	59(9.6%)	57(12.1%)	67(17.3%)	22(7.0%)	22(8.8%)
# Handlers reporting pesticide illness symptoms	0	0	0	0	0	0
Avg. days from referral to DOSH field visit**	34	13	20	12	7	5

*Declinations are reported through polling of medical clinics are mid-season

** Includes 9 consultation and 4 compliance visits

Medical Services

Fifteen medical clinics provided blood collection and medical evaluation services. Twelve clinics are located in Region 5, two in Region 1, and one in Region 4⁶. In preparation for the 2009 monitoring season the DOSH Occupational Nurse Consultant (ONC) contacted all participating

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

clinics. The ONC reviewed the rule and cholinesterase medical monitoring guidelines⁷ with each clinic, onsite training to 6 high volume clinics. All clinics reported satisfaction with the laboratory services and support provided by DOSH.

Pathology Associates Medical Laboratories (PAML) is the sole laboratory approved to provide testing services. There were no changes in Standard Operating Procedures⁸ from 2008 to 2009. 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 that same day.

The DOSH Industrial Hygiene Laboratory worked directly with PAML to track quality control indicators. These activities entailed weekly reviews of the internal quality control samples, charting of all internal quality control samples and monthly site visits to discuss QC review and status update. DOSH staff also participated in a limited QC program where DOSH staff was drawn on a monthly basis and the results were compared to other Quality Control data. All quality control indicators demonstrated good precision throughout the season. Dr. Barry Wilson's Laboratory at the University of California at Davis continued to provide consultation services.

Monitoring Summary

As in previous years, the vast majority of employers participating in the medical 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 counties accounted for the remainder of the samples submitted.

During the 2009 cholinesterase testing season (January 21 – October 11), ~217 growing operations participated in testing and 2,060 handlers submitted cholinesterase baseline tests. Baseline submissions increased slightly from 2008. This appears to be related to clinics encouraging baseline testing as a risk management strategy and employers incorporating baseline testing into hiring practices.

Of the 249 handlers who received at least one periodic test, 22 (8.8%) received at least one periodic test result with a >20 percent cholinesterase depression from baseline (action level cholinesterase depression) requiring the employer to evaluate pesticide handling practices for possible deficiencies. Of those same 22 handlers, 7 (2.8%) were temporarily removed⁹ from handling covered pesticides. The 22 pesticide handlers (all serum action level cholinesterase depressions) worked for 12 different employers, two employers accounted for 12 of the action level cholinesterase depressions. One of the handlers also experienced an action level cholinesterase depression in 2008. No handlers were identified with pesticide illness related symptoms. (see Pesticide Incident Review Tracking Panel reports for data on pesticide illness in Washington State <http://www.doh.wa.gov/ehp/PIRT/default.htm>)

⁷ <http://www.lni.wa.gov/Safety/Topics/AtoZ/Cholinesterase/files/ProvidersGuidelines1.pdf>

⁸ Available upon request

⁹ Employees may return to handling covered pesticides when cholinesterase levels return to within 20% of baseline. While medically removed from exposure to covered pesticides employee pay, seniority and other benefits are maintained at the pesticide handler level for a maximum of 3 months.

The rule allows employees to either choose to participate or decline participation in the employer's cholinesterase testing program. The option is consistent with other WISHA rules that contain medical surveillance provisions. As an additional protection against potential coercion regarding the handler's decision to participate in the program the rule includes the requirement that this decision is made in conversation with the health care provider. All clinics were asked to report handler declinations; 229 handler declinations were reported from 42 growing operations. DOSH opened compliance inspections with 12 growing operations which had ≥ 3 handlers decline testing. Thirty seven handlers were interviewed with no instances of employer coercion found. Reasons given for declining included; a) pain and fear of needles, b) limited to no handling of covered pesticides (e.g. organic operations), c) not receiving test results in previous years, d) never experiencing illness, and e) in one case handlers were sent in for periodic testing on a Friday. Since samples are not collected on Friday they were asked to come back on Monday, however the desk clerk also mistakenly had the handlers sign declination forms. Unfortunately this set of periodic tests was never done.

DOSH contacted the 3 employers who had ≥ 3 pesticide handlers with working baselines. All 3 were organic operations with either no use or limited use of cholinesterase inhibiting pesticides. The employers were educated as to the correct application of the rule.

Handler receipt of LHCP written recommendations has been an ongoing stakeholder concern. Of the 22 handlers with action level cholinesterase depressions DOSH did find that in one instance the employer did not provide a copy of the LHCP written recommendation to the handler. There were two additional instances where handlers had not been provided a copy of the LHCP written recommendation however the employers had not yet received the written recommendations from the health care providers. In addition, DOSH conducted 40 inspections in which compliance with the cholinesterase monitoring rule was evaluated. Four growing operations were cited for not providing copies of LHCP written recommendations (these operations did not have handlers with action level cholinesterase depression).

L&I Consultation and Compliance Findings

All 12 growing operations with handlers who had experienced action level cholinesterase depression received site visits by DOSH consultation or compliance services. The average number of days between a referral for consultation or compliance action was 5, with a low of 3 and high of 15.

In some cases the employer removed the handler from handling cholinesterase inhibiting pesticides, even though medical removal was not required, while waiting for DOSH to aid in the handling practice evaluation

Note: Upon interview 10 of the 22 handlers with action level cholinesterase depression reported that they had attended the WSDA hands-on pesticide training. Only 1 of these handlers could be matched by name and employer in the training attendance data base (2006-2009). Two additional handlers were identified by name but not matched by employer. As part of next year's interviews handlers will be asked if they can provide their training certification card.

Consultation Visit Summaries

Growing Operation 1: This consultation is in relation to a mixer, applicator that experienced a 25.74% serum cholinesterase depression. The handling hours reported in the 30 days prior to testing was 30.5. Covered pesticides handled in the 30 days prior to testing were Lorsban 4E and Carbaryl (Seven 4F a class III cholinesterase inhibitor was also applied).

Rule Violations:

WAC 296-307-61205: The handler when interviewed had a beard and indicated that he had been spraying while wearing his beard and a North half face respirator.

WAC 296-307-13045(6)(g)(iii): There was no written change schedule for the filters used on the North half face respirator.

WAC 296-307-14835: There was no completed written record of the findings of the work practice evaluation done after the company was notified of the action level cholinesterase depression.

WAC 296-307-60405: The handler's duties include wearing a fitted respirator to apply organophosphate containing pesticides. The handler has not undergone a respirator use medical evaluation.

WAC 296-307-13050(4): Emergency flushing water to carry or to be on the tractor while applying pesticides is not provided.

WAC 296-307-13025(3)(a): Written material or audiovisual training aids were not used to provide required WPS training.

Potential Over-Exposure Scenarios:

The handler reported that he had mixed covered pesticides while wearing ripped gloves.

Growing Operation 2: This consultation is in relation to an applicator that experienced a 28.82% serum cholinesterase depression. The handling hours reported in the 30 days prior to testing was 30.0 . Covered pesticides handled in the 30 days prior to testing were Lorsban 4E.

Rule Violations:

WAC 296-307-13025(3)(d)(viii): Pesticide handler found to be removing chemical resistant hood in order to look back at spray boom while conducting application and making turns. The handler also mentioned taking gloves off while unclogging plugged nozzles on the spray equipment.

Potential Over-Exposure Scenarios:

Removing hood while applying and removing gloves to unplug spray nozzles

Growing Operation 3: This consultation is in relation to a mixer, loader, applicator that experienced a 30.11% serum cholinesterase depression. The handling hours reported in the 30 days prior to testing was 38.0. Covered pesticides handled in the 30 days prior to testing were Lorsban 4E (Sevin 4F a class III product was also handled).

Rule Violations:

WAC 296-307-13045(6)(i)(ii): The area in front of the employees' lockers is used by pesticide handler/applicators to change into personal protective equipment. This is a concrete floor covered with dirt and gravel. The area is not clean and has no place for workers to sit if needed to put on or take off boots.

WAC 296-307-14835: There was no completed written record of the findings of the work practice evaluation done after notification of the handler's action level cholinesterase depression.

Potential Over-Exposure Scenarios:

The handler reports removing gloves when cleaning spray nozzles and smoking while on lunch and bathroom breaks. Also reports an incident where he felt feeling spray on his face when cleaning nozzles even though he was wearing full PPE.

Growing Operation 4: This consultation is in relation to a loader, mixer, applicator that experienced a 20.92% serum cholinesterase depression. The handling hours reported in the 30 days prior to testing was 30.0. Covered pesticides handled in the 30 days prior to testing were Lorsban 4E (Seven 4F a class III product was also handled).

Rule Violations:

WAC 296-307-61205: The handler was found to have a beard and was a designated respirator user. The beard may interfere with the proper fit and seal of the half face respirator rendering it less effective.

WAC 296-307-13025(3)(a): The training provided the handler did not include written material or audiovisual training aids.

WAC 296-307-12025(3)(f)(iii): The designated sign prohibiting entry into an orchard was posted on an orchard that had not been sprayed for quite some time. The foreman indicated that the sign was kept up to keep kids going home from school out of the orchard.

WAC 296-307-14835: There was no written record of the findings of the work practice evaluation done after the company was notified of the cholinesterase depression.

Potential Over-Exposure Scenarios:

Poor fitting respirator and facial hair inhibiting respirator seal.

Growing Operation 5: This consultation is in relation to a loader, mixer, applicator that experienced a 37.30% serum cholinesterase depression. The handling hours reported in the 30

days prior to testing was 70.0. Covered pesticides handled in the 30 days prior to testing were Lorsban 4E and Carzol SP.

Rule Violations:

WAC 296-307-14835: There was no written record of the findings of the work practice evaluation done after the company was notified of the action level cholinesterase depression.

WAC 296-307-13025(3)(a): No written material or audiovisual training aids were used to provide WPS required training.

WAC 296-307-13045(6)(g)(iii): There was no written change schedule for the filters used on the Kasco K80S helmet Respirator.

Potential Over-Exposure Scenarios:

Handler reports that he was sprayed in the face when while performing spray nozzle maintenance.

Growing Operation 6: This consultation is in relation to 4 loader, mixer, applicators that experienced 43.72%, 23.91%, 25.39%, and 64.12% serum cholinesterase depressions. The handling hours reported in the 30 days prior to testing were 41.5, 38.0, 47.5, and 40.5 respectively. Covered pesticides handled in the 30 days prior to testing were Lorsban 4E for 3 of the handlers, and Lorsban 4E and Carzol SP for the remaining handler. (43.72% cholinesterase depression).

Rule Violations:

WAC 296-307-14835: There was no written record of the findings of the work practice evaluation done after the company was notified of the cholinesterase depressions.

WAC 296-307-61205: One handler was found to have a beard and was a designated respirator user.

WAC 296-307-13025(3)(b): The WPS training was not conducted by a qualified individual but by co workers who did not use written materials.

Potential Over-Exposure Scenarios:

Handlers reported that they do not always have time to perform complete decontamination of PPE and equipment, “tractors are washed about every 3 days”.

One handler had facial hair interfering with respirator seal.

Growing Operation 7: This consultation is in relation to 7 applicators that experienced 46.14%, 67.86%, 20.69%, 26.01%, 43.8%, 47.39%, and 53.29% serum cholinesterase depressions. The handling hours reported in the 30 days prior to testing were 36.0 for all of the handlers. Covered pesticides handled in the 30 days prior to testing were Lorsban 4E.

Rule Violations:

WAC 296-307-13045(6)(a): All handlers indicated that they only used soap occasionally when washing their chemical resistant rain gear. They further indicated that on many occasions they do not wash the PPE at the end of the day due to being hurried.

WAC 296-307-61205: One handler (47.39% cholinesterase depression) was found to have a beard and was a designated respirator user. The beard may interfere with the proper fit and seal of the full face respirator rendering it less effective.

WAC 296-307-60605: Both North half and full face respirators are used. The handlers had only been fit tested to the full face respirator.

WAC 296-307-13045(6)(i)(ii): The area used by pesticide handler/applicators to change into personal protective equipment was maintained but the floor was wet. The water extended to most of the floor in front of the employees lockers.

WAC 296-307-14835: There was no completed written record of the findings of the work practice evaluation done after the company was notified of the Cholinesterase depressions.

WAC 296-307-14830: The medically removed handlers were paid a dollar less per hour than when they were applying.

Potential Over-Exposure Scenarios:

Wearing respirators that were not fit tested and one respirator user with facial hair.

Handlers reported that they do not always have time to perform complete decontamination of PPE and equipment.

Wearing contaminated PPE

Growing Operation 8: This consultation is in relation to a loader, mixer that experienced a 38.72% serum cholinesterase depression. The handling hours reported in the 30 days prior to testing was 32.5. Covered pesticides handled in the 30 days prior to testing were Lorsban 4E.

Rule Violations:

WAC 296-307-13045(6)(g)(iii): Handler exceeded eight hours use without replacing cartridges.

WAC 296-307-13050(6): Insufficient water at decontamination site. Employees hauling water in buckets from approximately 100 feet away.

WAC 296-307-13045(6)(a): Respirators found to be dirty and stored with cartridges and filters attached. Chemical resistant suits were found in similar conditions.

WAC 296-307-12030(3): The required notice of applications was not displayed at the Central Notification Board.

Potential Over-Exposure Scenarios:

Use of expired respirator cartridges.

Insufficient decontamination and use of contaminated PPE.

Growing Operation 9: This consultation is in relation to a mixer, loader, applicator that experienced a 27.31% serum cholinesterase depression. The handling hours reported in the 30 days prior to testing was 28.0. Covered pesticides handled in the 30 days prior to testing were Lorsban 4E.

Rule Violations:

WAC 296-307-13025(1): The handler was not trained in accordance with the pesticide safety training requirements for handlers.

WAC 296-307-60405: Employer failed to provide medical evaluations for employees required to use respirators as part of their duties.

WAC 296-307-62015: The handler failed to properly clean and disinfect respirator, storing it with organic vapor removing cartridges and pre filters attached. Two other respirators were found in the same condition.

WAC 296-307-13045(6)(f)(iv): Respirator cartridges were not changed out during a 28 hour application period.

WAC 296-307-13045(6)(g)(iii): The handler used a TC23C North half-face respirators with vapor removing cartridges and exceeded eight hour's of use without replacing cartridges.

WAC 296-307-30006(2): The employer's Massey Tractor model 135, had power takeoff driven equipment attached which had a damaged shaft cover.

WAC 296-307-018(5): Employer did not have a current OSHA 300 log, still using the 200 version.

Potential Over-Exposure Scenarios:

Inadequate respirator cartridge change-out schedule.

Failure to adequately decontaminate PPE

Lack of WPS compliant training.

Compliance Visit Summaries

Growing operation 10: This inspection is in relation to an applicator that experienced a 20.46% serum cholinesterase depression. The handling hours reported in the 30 days prior to testing was 2.5. Only Diazinon 50W a class II cholinesterase inhibitor was applied. The inspection was assigned to compliance after consultation first contacted the employer by telephone and the employer failed to schedule a consultation visit.

Proposed Citations:

None found.

Potential Over-Exposure Scenarios:

The handler does not shower after applying (spray blast method).

Growing Operation 11: This inspection is in relation to a mixer, loader, applicator that experienced a 31.41% serum cholinesterase depression. The handling hours reported in the 30 days prior to testing was 35.0. Covered pesticides handled in the 30 days prior to testing were Lorsban 4E and Phosmet (Sevin 4F a class III cholinesterase inhibitor was also handled). The inspection was conducted by compliance due to the fact that compliance was already on site following up on declinations when this handler experienced an action level cholinesterase depression. The employer agreed to the compliance inspection.

Proposed Citations:

None found.

Potential Over-Exposure Scenarios:

Not showering after application.

Growing operation 6: This inspection is in relation to an applicator that experienced a 26.82% serum cholinesterase depression. The handling hours reported in the 30 days prior to testing was 41.0. Covered pesticides handled in the 30 days prior to testing were Guthion and Imidan. The inspection was assigned to compliance after consultation had provided services to this operation earlier in the year due to 4 handlers experiencing action level cholinesterase depression.

Rule Violations:

None found.

Potential Over-Exposure Scenarios:

None found

Growing Operation 12: This inspection is in relation to a mixer, loader, applicator that experienced a 23.75% serum cholinesterase depression. The handling hours reported in the 30 days prior to testing was 39.5. Covered pesticides handled in the 30 days prior to testing were Lorsban 4E (Sevin 4F a class III product was also handled). The inspection was assigned to compliance after the employer declined a consultation visit.

Rule Violations

WAC 296-307-28016(2)(a): Two instances of unguarded PTO shafts were found.

WAC 296-307-14815: The handler had not been provided a copy of the LHCP written recommendation. However, had been notified by the employer of the action level cholinesterase depression.

Potential Over-Exposure Scenarios:

The handler reports that the respirator sometimes slips.

Conclusion

In conclusion, the 2009 cholinesterase monitoring program functioned well. DOSH continues to work with all stakeholders to make improvements where indicated, e.g., ensuring pesticide handlers receive copies of the health care provider's written recommendations. Information gleaned from field evaluations continues to prove useful. For example, the information gleaned from field evaluations is used by DOSH and WSDA in developing pesticide handler training curriculum

Laboratory services have been solidified and are monitored to identify and limit potential areas of bias and analytical variability. Dr. Barry Wilson's laboratory and the DOSH Industrial Hygiene Laboratory have worked closely with PAML to maintain strong services.

DOSH would like to thank all of those individuals, stakeholders and entities involved in supporting the L&I Cholinesterase Monitoring Program, with particular appreciation to: Pathology Associates Medical Laboratories (PAML); the University of California Davis - Dr. Barry Wilson, Mr. Jack Henderson; the DOSH field consultation and compliance staff; and all participating health care providers.