Cholinesterase Testing Protocols for Healthcare Providers

When to Test?

Cholinesterase-Inhibiting Pesticides

Test if working with Class I or Class II organophosphates (OPs) or OPs and N-methyl-carbamates for greater than a total of 30 hours in 30 consecutive days.

N-Methyl-Carbamates

If only working with N-methyl-carbamates, cholinesterase testing is not likely to be beneficial.

Baseline

Baseline Determination

Obtain baseline measures prior to working with cholinesterase-inhibiting pesticides. When obtaining the baseline, ensure that cholinesterase-inhibiting pesticides has not been handled in the immediate 30 days prior to testing.*

Second Baseline

A second baseline is recommended for improved precision but not essential. Wait to test at least three days after the baseline, but no longer than 14 days (OEHHA, 2017). If a second baseline is obtained, average the two values. For accuracy, ensure no pesticide exposures during this time period.

Establish baselines annually.

Working Baseline

Working baselines (baselines that are established when a 30-day period free of OPs exposure is not possible) are likely to increase false negatives. Perform a second baseline after halting exposure (the longest practicable exposure-free period available is recommended, with a one-week exposure-free period at a minimum). If values differ by more than 10%, obtain a third baseline. The highest value should be used as the baseline.

Testing

Test Types

Measure both *acetylcholinesterase* (red blood cell cholinesterase; RBC ChE) and *butyryl cholinesterase* (plasma cholinesterase; Plasma ChE). Both RBC ChE and Plasma ChE tests are recommended. If only performing one test, do Plasma ChE.

Laboratory Services

Use the same laboratory and the same methodology for all testing so that results may be accurately compared.

Post-Exposure Testing

Washington state recommends testing each time a worker exceeds or reaches 30 hours of exposure within any 30-day period after the baseline is established or after last post-exposure test. California state recommends testing each time a worker exceeds or reaches 6 days of exposure within a sliding scale 30-day period.

Medical Removal

Remove worker from cholinesterase-inhibiting pesticide exposure if their RBC ChE is less than 70%, and/or their Plasma ChE is less than 60% of the baseline.

Level to Return to Handling

Return to Handling

Return to handling when RBC ChE and Plasma ChE are both greater than or equal to 80% of baseline.

Retest for Return to Work

Days to repeat test is determined by degree of reduction in cholinesterase activity or may consider testing weekly.

For RBC ChE: (% depression – 20) /0.83 = number of days to repeat test

For Plasma ChE: (% depression – 20) /1.2 = number of days to repeat test

Review of Handling Practices

Review pesticide handling practices when test results are less than 80% of baseline.

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*Revised on 02/16/2023 by **Steven Kirkhorn, MD, MPH** and **Matthew Keifer, MD, MPH, National Farm Medicine Center external scientific advisor.***

Resources

Brown, A., Miller, M., & Keifer, M. (2013). No. 30: Cholinesterase monitoring – A guides for the health professional. *Pesticide information leaflet*. University of Maryland Extension. pesticide.umd.edu/uploads/1/3/5/6/13565116/pil30_che-hcps_1999-2013.pdf.

Furman, J. (2010). *Cholinesterase monitoring for agricultural pesticide handlers: Guidelines for health care providers in Washington state*. Washington State Department of Labor and Industries: Division of Occupational Safety and Health. lni.wa.gov/ safety-health/_docs/Providers Guidelines 1.pdf.

The Office of Environmental Health Hazard Assessment. (2017). *Guidelines for physicians who supervise workers exposed to cholinesterase inhibiting pesticides* (6th edition). California Environmental Protection Agency. oehha.ca.gov/pesticides/california-medical-supervision-program.

Roberts, J. & Routt Reigart, J. (2013). *Recognition and management of pesticide poisonings* (6th edition). U. S. Environmental Protection Agency: Office of Pesticide Programs. epa.gov/sites/default/ files/2015-01/documents/rmpp_6thed_final_lowresopt.pdf.

**Handling of pesticides refers to tasks such as mixing, loading, transferring or applying pesticides; handling open containers of pesticides; acting as a flagger; cleaning, handling, adjusting or repairing pesticide equipment; or assisting with the application of pesticides.*

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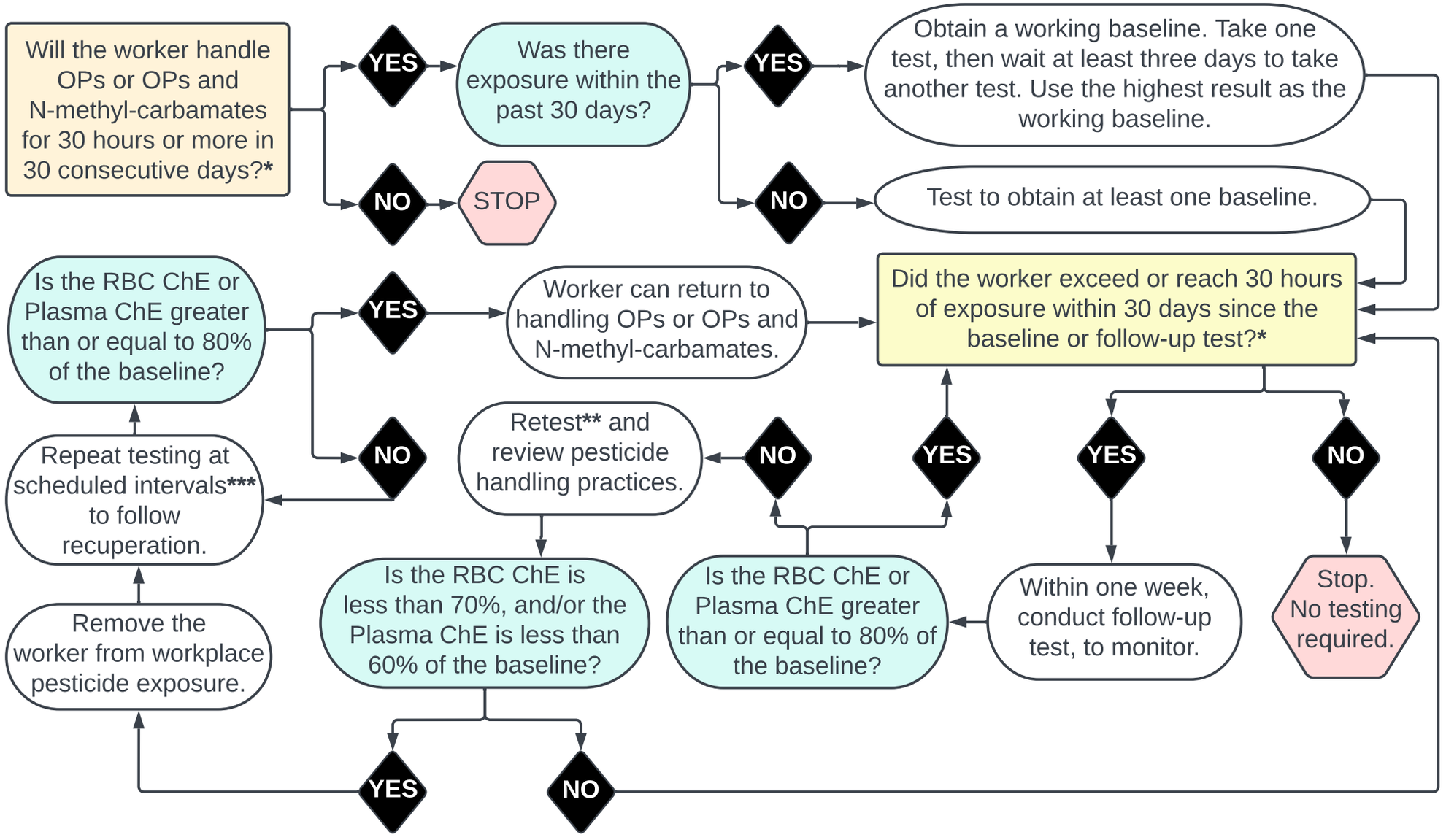
Cholinesterase Testing Protocol Algorithm



*This is the Washington (WA) state recommendation. California (CA) state recommends follow-up testing if worker reaches 6 days of exposure within a sliding 30-day schedule. At this time, WA and CA are the only states with formal cholinesterase monitoring programs with regard to pesticide exposure. Days of exposure are easier to track than hours of exposure.

**Retesting is strongly recommended but not mandatory.

Threshold exposure level: When the worker exceeds or reaches 30 hours of exposure in a 30-day period.
OPs: Class I or Class II organophosphates.
RBC ChE: Acetylcholinesterase, also known as red blood cell cholinesterase.
Plasma ChE: Butyryl cholinesterase, also known as plasma cholinesterase.

NOTES:
- Obtain baseline prior to pesticide work or after 30 days of worker being exposure free.
- When testing, it is recommended to get both RBC ChE and Plasma ChE. But if only performing one test, then do Plasma ChE.
- A second baseline is recommended for improved precision but not essential.
- N-methyl carbamates do inhibit cholinesterase but the cholinesterase reactivates quickly, making testing unreliable in predicating overexposure.

***Days to repeat test:**
- For RBC ChE: (% depression - 20) /0.83 = number of days to repeat test.
- For Plasma ChE: (% depression - 20) /1.2 = number of days to repeat test.

Testing weekly is also acceptable.

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