FACT SHEET #4 Health Problems Associated with Chlorpyrifos and Other OPs

A) Acute Poisonings. A review of acute pesticide poisoning cases among agricultural workers in the U.S. from 1998 to 2005 found that 54% of the *reported* cases involved insecticides. (http://onlinelibrary.wiley.com/doi/10.1002/ajim.20623/abstract)"Cholinesterase inhibitors" – pesticides that depress the nervous system enzyme "cholinesterase", i.e. organophosphates and carbamates - were involved in 51% (892 cases) of those cases. Chlorpyrifos was involved in more cases than any other insecticide (190 of the 892 cases) Other organophosphates that ranked high included methamidophos (130 cases) dimethoate (84), malathion (78) and diazinon (70). The review included only workers, and most pesticide poisoning cases are likely not reported. Examples of acute poisoning cases from Washington State include the following: (

1) Ten Workers Sickened by Chlorpyrifos, Spring of 2010 (Link to DOH report). The workers sought medical care after chlorpyrifos drifted onto them as they worked in an orchard. Symptoms included vomiting, stomach cramps, diarrhea, eye irritation, skin sensitivity, seating, watery eyes, dizziness and headaches.

2) Farm Worker Spraying Chlorpyrifos Sickened, March 2007: According the Department of Health write-up for this case, "a 39-year-old male farm worker was spraying apples and wearing PPE. He reported the mask didn't fit properly. He developed dermal and neurological symptoms from the pesticide exposure and went to the hospital the next day. He reported the problem to his employer afterward and the full face mask was returned to supplier for repairs."

3) Six Farm Workers Tending Grapes Sickened by Drifting Malathion, June 2002: Six vineyard and orchard workers had to be taken to area hospitals after the organophosphate pesticide malathion drifted onto them from an application at a nearby orchard. They suffered nausea, vomiting, headaches, burning eyes, blurred vision, and other health effects. Maria Mendoza, one of the sickened workers, and a signatory on the letter to EPA, explains: "It was terrible for me and my co-workers to be poisoned by pesticides that drifted onto us. I worry that my children will be poisoned like I was, and about them being exposed over time, even without being poisoned."

B) Less Immediately Obvious Neurological Impacts.

Laboratory Animal Studies. Dr. Theo Colborn and her colleagues at The Endocrine Disruption Exchange (TEDX) have added chlorpyrifos to their publicly-accessible on-line database, Critical Windows of Development (link). The website lays out examples of laboratory research that link prenatal, low dose chlorpyrifos exposures in animals to altered health outcomes in the brain and other organs. (http://www.endocrinedisruption.com/prenatal.criticalwindows.overview.php; Dr. Colborn: 950-527-4082) For example, in a study published in 2010, University of Wisconsin researchers. "demonstrated that environmentally relevant levels of *in utero* chlorpyrifos exposure cause a marked learning latency in females but not in males." (http://www.zoology.wisc.edu/faculty/Por/pdfs/mice.pdf)

Human Studies. Numerous human studies link organophosphates to neurological impacts. No study alone proves that chlorpyrifos and other organophosphates impair neurological development and functioning, and scientists generally call for more research and include caveats

about interpreting results. But taken together and in the context of laboratory findings, the human studies are cause for grave concern. Examples include:

1) Organophosphates Linked to ADHD in the General Population Researchers reviewed information collected from children representative of the US general population, including levels of organophosphate residues in their urine, and evidence of attention deficit hyperactivity disorder (ADHD). The study's findings "support the hypothesis that organophosphate exposure, at levels common among US children, may contribute to ADHD prevalence." (http://pediatrics.aappublications.org/cgi/content/abstract/125/6/e1270 .

2) Organophosphates and Neurological Impacts in Farm Workers' Children in California. Researchers in California measured OPs in pregnant farm worker community women's urine, and have been tracking their children since birth. They concluded that prenatal OP metabolites in the mothers "were associated adversely with attention in young children…." (In other words, higher prenatal exposures were associated with reduced attention capacity.) "These associations were more robust at 5 than 3 ½ years and stronger in boys." (http://ehp03.niehs.nih.gov/article/info:doi/10.1289/ehp.1002056) Earlier studies found that among infants more than 3 days old, increasing average organophosphate metabolite levels in the mothers' urine prenatally were associated with both an increase in the number of abnormal reflexes and in the proportion of infants with more than three abnormal reflexes. http://www.iceh.org/pdfs/LDDI/InUteroPesticidesEskenazi.pdf .

3) Prenatal Exposures to Chlorpyrifos in New York City Associated with Developmental Delays. Researchers measured chlorpyrifos in umbilical cord blood at birth to estimate prenatal exposures. When the children were three years old those with higher prenatal exposures were significantly more likely to experience psychomotor and mental development delays, attention problems, attention-deficit/hyperactivity disorder, and pervasive developmental disorders compared to the children with lower exposures. (http://pediatrics.aappublications.org/cgi/reprint/118/6/e1845) At birth researchers had concluded that "(r)esults indicate that chlorpyrifos exposures have impaired fetal growth…and that diazinon [another OP] exposures may have contributed to the effects." Further, they found that associations between birth weight and length and chlorpyrifos and diazinon found in umbilical cord blood "were highly significant among newborns born before the 2000-2001 U.S. Environmental Protection Agency's regulatory actions to phase out residential use of these insecticides. Among newborns born after January 2001, exposure levels were substantially lower, and no association with fetal growth was apparent." (http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info:doi/10.1289/ehp.6641) Both chlorpyrifos and diazinon are still used in agriculture.

4) Poorer Neurobehavioral Performance Among Workers and Children Exposed to OPs in Agricultural Areas. Agricultural children aged 2 to 6 performed more poorly on measures of response speed and latency as compared to similar non-agricultural children in research conducted in Oregon and North Carolina. Researchers noted that the modest differences they found "are consistent with functional effects seen in adults exposed to low concentrations of OP pesticides."(http://www.ncbi.nlm.nih.gov/pubmed/16112324) They

also found that the neurobehavioral performance of the farm workers was lower than that of the nonagricultural adults. Among farm workers there was a positive correlation between urinary organophosphate metabolite levels and poorer performance on some neurobehavioral tests. Deficits were seen for sustained attention, information processing and motor speed and coordination.
(http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info:doi/10.1289/ehp.8182)

5) Higher Rates of Neurological Symptoms Among Pesticide Applicators. In a study of over 18,000 applicators in North Carolina and Iowa, researchers found associations people reporting higher numbers of neurologic symptoms in the previous year and their cumulative lifetime use of organophosphates. These associations persisted even after excluding individuals who had a history of pesticide poisoning or an event involving high exposure. (http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info:doi/10.1289/ehp.7645)

6) Studies Finding Children Are Far Less Able to Detoxify Chlorpyrifos than Thought. Detoxification of chlorpyrifos depends on an enzyme called paraoxonase-1 (PON1). A California study in a largely farm worker community showed that among newborns PON1 levels varied by 26-fold. On average, children's PON1 levels were four-fold lower than the mothers' PON1 levels. The predicted range of variability in sensitivity of mothers and children was 164-fold for chlorpyrifos.
http://ehs.sph.berkeley.edu/Holland/Genomics/statuspaper.pdf Lower levels persist through at least age seven.(http://ehp03.niehs.nih.gov/article/info%3Adoi%2F10.1289%2Fehp.0900870) The implications of this information are broad. A recent study looked at DNA from newborns in California and Washington State, for example. Researchers concluded that "exposure in childhood to organophosphorus and perhaps to carbamate insecticides in combination with a reduced ability to detoxify them may be associated with CBT", i.e. "Childhood Brain Tumors".
http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info%3Adoi%2F10.1289%2Fehp.0901226

C) Prevalence of Learning Disability and Other Problems.
Autism, attention deficit hyperactivity disorder (ADHD), dyslexia, intellectual disability (formerly termed mental retardation), lowered IQ and other disorders of learning, development, and behavior are highly prevalent among American children. Increased awareness and improved diagnosis play a role in current figures, but studies controlling for those factors infer that other culprits may be at play. For statistics and references to relevant studies, see page 8 of the report Mind Disrupted. (http://minddisrupted.org/documents/Mind%20Disrupted%20report.pdf).

D) Other Health and Environmental Effects Chlorpyrifos and other organophosphates are associated with other health effects such as respiratory disease, injury to bees and other wildlife, etc. While this fact sheet only provides examples of studies bearing primarily on neurological impacts in humans, this does not mean that the effects of exposure are limited to those sorts of impacts.