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Re: Bill HF670 – Chlorpyrifos sale, use, and application banned; product recall and collection efforts required; and money transferred
Submitted to: Agriculture Finance and Policy
Position: In support of Bill HF670

Members of the Committee,

I am an Associate Professor in the Department of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai in New York. I investigate the relationship between early life exposure to environmental toxicants and adverse neurodevelopmental outcomes, including changes in children's brain structure and function. I am providing this written testimony as an environmental health expert and as a leading researcher in the studies finding that exposure to chlorpyrifos harms children's brains.

I strongly support the passage of Bill HG670 to ban all uses of chlorpyrifos in the state of Minnesota. Consistent evidence across animal studies and epidemiological studies demonstrate that chlorpyrifos is a powerful developmental neurotoxicant and that early life exposure to chlorpyrifos is associated with persistent adverse outcomes in children, including changes in brain structure. I believe this bill is essential to help protect the health of Minnesota's most vulnerable populations: pregnant women and children.

The scientific evidence of neurotoxic dangers associated with chlorpyrifos exposure is extensive and consistent. Three recent epidemiologic studies demonstrate that exposure to chlorpyrifos during pregnancy is harmful to children's brains and that damage persists throughout childhood. These three studies, based on different populations, located in distinct geographical regions of the US, and using different biomarkers of exposure, have produced strongly convergent results. One study from the University of California at Berkeley reported reductions in IQ scores among the children of agricultural workers in the Salinas Valley. The second study was undertaken at my institution, the Icahn School of Medicine at Mount Sinai, and found similar results in a New York City Hispanic population. The third study, also conducted in New York City by investigators at Columbia University among a population of African-American and Dominican children determined that prenatal chlorpyrifos exposure negatively impacted children's brain development. These data sets all support the need to protect children from early life exposure to chlorpyrifos.

Building upon these epidemiologic studies demonstrating associations between early life chlorpyrifos exposure with behavioral and cognitive outcomes in children, Columbia University undertook an MRI study to inform our understanding of the influence of prenatal and early childhood chlorpyrifos exposure on brain regions regulating behavior and cognition in children. In this work, we evaluated the brains of 40 children, ages 5 to 11, whose mothers were enrolled during pregnancy into the Columbia University Mother's and Newborn's Study. This is a non-clinical, representative community-based cohort enrolled from Northern Manhattan and the South Bronx in New York City. We compared the brain scans of 20 children with higher levels of chlorpyrifos exposure (as measured in umbilical cord blood collected at birth) to 20 age- and sex- matched control subjects with lower chlorpyrifos levels. The brain scans of children with higher chlorpyrifos exposure looked markedly different compared with those of children exposed to lower levels of chlorpyrifos. Changes were visible across the surface of the brain, with abnormal enlargements of some areas and thinning in others. Although the study did

not examine specific disorders tied to any of these brain changes, the regions affected are associated with functions such as attention, decision making, language, impulse control and working memory. These changes in brain structure are consistent with the cognitive and behavioral deficits observed in children exposed to this chemical, and consistent with animal literature linking early life exposure to low levels of these chemicals to adverse neurodevelopmental outcomes.

The high chlorpyrifos group also displayed disruption of normal sexual differences in brain structure – effects that were not observed in the low chlorpyrifos group. Expected sex differences (i.e., enlargement of the right inferior frontal lobe) were reversed in the high chlorpyrifos group. These findings are consistent with animal models suggesting that chlorpyrifos exposure reverses normal sexual differences in rates of learning, memory and emotional behaviors.

Notably, the adverse cognitive and motor outcomes and the brain abnormalities observed in these studies appeared to occur following low-level exposures to chlorpyrifos in non-occupationally exposed, community-based samples. **These affects are seen at exposure levels are below EPA safety standards**. This suggests that the mechanisms underlying brain changes may involve other pathways and occur at lower levels than anticipated based on systemic toxicity. And further, it suggests that the current EPA safety standards do no protect vulnerable populations such as the developing infant and small child from the adverse impacts of chlorpyrifos.

In summary, residential exposure to chlorpyrifos in a non-clinical, community-based sample is associated with persistent changes in the morphology of brain regions that support cognitive and behavioral outcomes. These associations occur at levels below the threshold for systemic toxicity suggesting that the fetal and developing brain is uniquely vulnerable to this chemical. These findings, together with decades of animal and epidemiologic research confirm the toxic dangers posed by exposure to even low levels of chlorpyrifos. Based on this evidence, Minnesota lawmakers should enact Bill HF670 and ban all uses of chlorpyrifos in the state of Minnesota. It is the right thing to do to protect the health of Minnesota's children and future.

Megan K. Horton, PhD, MPH *is an Associate Professor of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai.*

Dr. Horton is an environmental health scientist with expertise in environmental epidemiology, child neurodevelopment and pediatric neuroimaging. Following her doctoral training in environmental health at Columbia University, she completed a postdoctoral fellowship in neuroepidemiology where she learned to apply magnetic resonance imaging (MRI) to investigate the impact of prenatal exposure to pesticides and secondhand smoke on neuropsychological and behavioral function throughout childhood. In 2010, she received a prestigious NIH-funded career transition award to study co-exposure to endocrine disrupting chemicals (e.g., polybrominated flame retardants, perchlorate, pyrethroid insecticides) and structural and functional brain outcomes in a New York-based longitudinal birth cohort. This award included extensive training in study design and statistical approaches for linking early life exposures to complex chemical mixtures with neuroimaging data to evaluate changes in brain structure and function in children. Her work has been highlighted at national and international meetings.