

# Chapter 8

## Conclusion



Several important themes emerge from the research reviewed in this report.

**1. Neurodevelopmental disabilities are widespread, and chemical exposures are important and preventable contributors to these conditions.**

Reductionist analyses that separately address environmental and genetic factors may illuminate important details but fail to acknowledge the complexities of multiple, interacting factors that ultimately influence neurological development. Both genetic factors and environmental factors must be simultaneously considered to properly understand these disabilities.

**2. Our initial understanding of the impacts of neurotoxic substances regularly underestimates the potential for harm.** So called “safe” exposure thresholds regularly become obsolete as research methods improve.

**3. Carefully conducted, long-term epidemiological studies have proven to be much more sensitive measures of developmental neurotoxicity than animal studies.** Thus, animal models may greatly underestimate true human risks. Indeed, it would be surprising if

this were not the case, considering the unique capacities and complexities of the human nervous system.

**4. Regulatory policy has repeatedly failed to protect children from widespread harm due to exposures to developmental neurotoxins.** Due to the extremely slow rate at which proof of safety or harm materializes, generations of children are at risk, and often harmed, before an adequate regulatory response can occur. Timely action can be ensured only by regulatory processes that are capable of responding during the extended period between the earliest evidence and more complete scientific understanding of the danger.

**5. The failure of the regulatory system to protect public health can often be traced to the influence of vested economic interests upon the regulatory process.** Special interests commonly use a variety of tactics to delay or diminish the regulatory response to public health threats. One obstacle to timely action is the frequent presumption that chemical exposures are harmless until a complex, expensive, and rigid process for identifying toxicity and health threats is completed.

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**6. Neurodevelopmental disabilities impose social and economic costs upon impacted families and the economy as a whole.** Preventing these disabilities has the potential to provide major economic benefits.

**7. Special interests are not merely tolerated but are actually an integral part of the regulatory process.** If we are to successfully respond to the threats posed by the use and environmental releases of neurotoxic chemicals, we must find a way to insulate public health decision-making from conflicts of interest that can corrupt it.

### **Simplistic Analysis Fails To Address The Complex Causes Of Developmental Disabilities**

Genetic and environmental factors interact in complex ways to cause the learning disabilities and cognitive disorders discussed in this report. Yet, in keeping with current toxicological, genetic, and epidemiological research strategies, most research continues to focus on one domain at a time, as if comprehensive understanding would emerge by simply adding up the contributions of each.

This reductionist approach to complex problems characterizes biomedical research in the 20th century. Though dissecting problems into component parts helps to illuminate important details, a broader integration must be accomplished before we can truly understand the infinitely more complex real world, where genetic, environmental, and social factors

combine. For the purposes of comprehensive understanding, prevention, and public health protection, these isolated factors must be conceptually reassembled and considered as an integrated whole.

### **Neurodevelopmental Disabilities Are Expensive Not Only For Families, But For Society As A Whole**

Learning and behavioral disabilities are associated with early drop out from high school, substance abuse, unemployment, teen-parenting, welfare dependence, and incarceration. The enormous financial costs of these problems are borne by families, schools, local and national governments, and by businesses faced with workforce disabilities and rising health insurance premiums. Regulatory decisions that affect the neurodevelopment of children impact not only health, but all aspects of society, including the economy as a whole. Indeed, healthy families and a healthy workforce are essential pillars of a vibrant economy.

### **Regulatory Policy Has Repeatedly Failed To Protect Children's Health**

An historical review of our understanding of the risks of neurotoxic chemicals reveals a disturbing pattern. As a rule, these chemicals are recognized as harmful long after their use has become routine and exposures have become widespread. Because the fetus and developing child are most sensitive to the effects of these insidious exposures, children bear the burden of regulatory

policies that largely consider chemicals safe until proven harmful. After a century of intensive study, the harm from perhaps the single most-studied neurotoxicant can be characterized with fair certainty. Since childhood lead exposure has been ongoing since lead paint was first introduced in the 1890s, five generations of children have been injured while science slowly advanced to where it is now capable of appreciating the magnitude of the problem. This same pattern of “after-the-fact” recognition of harm has been repeated for mercury, PCBs, pesticides, alcohol, and nicotine. In each instance, what we initially believed to be a “safe” exposure level steadily dropped as understanding improved.

With thousands of potentially neurotoxic chemicals in widespread use, our snail’s pace approach to regulation clearly sets children in a minefield of uncertainty and potential harm, where the full extent of current hazards will be unknown for the foreseeable future. Meanwhile, thousands of new chemicals come into production and use, creating new exposure hazards. Even when there is substantial evidence of hazard, chemicals continue to be inflicted on the unsuspecting public for decades, as painstaking scientific study slowly clarifies precise magnitudes of risk and cellular mechanisms of harm. Without such information, the regulatory system does not easily respond. Rigid adherence to an inflexible standard for justifying action prevents timely regulatory response to public health threats. As a result, the regulatory

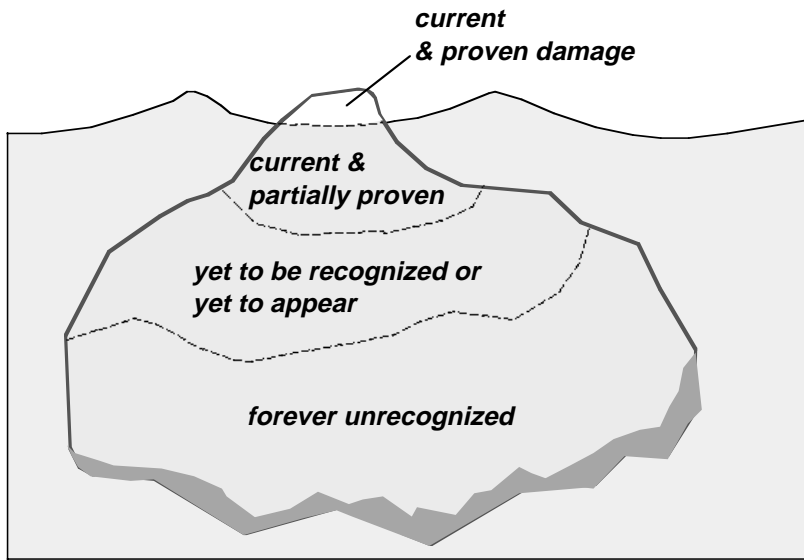


system often serves special economic interests at the cost of children’s health.

Individual chemicals or classes of chemicals, for which there is plausible evidence of toxicity, should not be considered innocent until fully proven guilty. Rather, such chemicals ought to be regulated in a precautionary manner, much as we regulate pharmaceutical chemicals - shifting the “burden of proof” so that some basic evidence of safety is required before public exposures are permitted. Pharmaceuticals are bioactive chemicals, which people take by choice and which have favorable risk/benefit profiles. Environmental chemicals, on the other hand, are bioactive substances that people usually do not take by choice, but are often exposed to, in varying amounts, without their knowledge or consent. In addition, environmental chemicals that carry risks do not, as a rule, provide countervailing health benefits. Clearly, the public deserves the same measure of protection from involuntary environmental exposures, which may be hazardous, as from voluntary pharmaceutical exposures that have therapeutic benefit.

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## Tip of the Iceberg



The regulatory process addresses those few chemicals for which there is rigorous proof of harm, but such harm is likely to be the tip of the iceberg. There is a deeper level at which emerging harm can be identified but is not fully proven, despite clear warning signs. Below this, there are damages that occur with long latency periods, in which harmful exposure has occurred but the manifestation of the damage has yet to appear. And below this there are exposures that are harmful but which will never be recognized due to the difficulties of detection.

There are approximately 80,000 chemicals in the U.S. inventory, with one-to-two thousand new chemicals introduced each year. Since chemical exposures proliferate much faster than their neurodevelopmental toxicities can be understood, the true dimensions of the toxic threat will always be underestimated by "currently available knowledge".

Finally, risks and benefits often accrue to very different groups and are typically not equitably distributed. While manufacturers and particular groups of consumers may benefit from an industrial product or process that utilizes or releases neurotoxic substances, the risks of toxic exposures are often borne by others, such as cultural minorities or economically disadvantaged or socially marginalized groups. For example, children of urban inner cities or children of migrant farm workers are disproportionately exposed to pesticides or other neurotoxic substances. Subsistence fishing among less affluent ethnic communities, due both to economic necessity and cultural tradition, results in increased exposure to fish-borne neurotoxicants, including mercury, dioxin, and PCBs.

### Conflicts Of Interest Are An Accepted Part Of The Regulatory Process

In environmental public health decision making, the strong influence of vested economic interests is currently

an expected part of the regulatory process. Advocates for public health and representatives of special, corporate interests routinely lock horns in the course of scientific deliberations, in which the parties are considered "stakeholders" of equal importance. This process allows voices into public health decision making that are obviously financially conflicted and often willing to expend considerable sums of money to ensure that a particular financially advantageous action is taken. The failure of the regulatory process to guard against these influences contributes to the lack of children's health protection. Allowing financially conflicted interests a central role in the regulatory arena creates a steeply tilted playing field favoring corporations with enormous political and economic influence.

Corporate influence on the regulatory process may include a range of pervasive political and financial pressures, including political lobbying, campaign contributions, well-financed public relations

campaigns, biased interpretation of scientific evidence, and selectively funded research. Unfortunately, public agencies widely perceived as the defenders of public health are often compelled by political pressures to assume the role of mediator between public and corporate interests, rather than advocating on behalf of a safe, healthy environment. It is no surprise that these agencies, thus compromised, are incapable of fully protecting the health of our children.

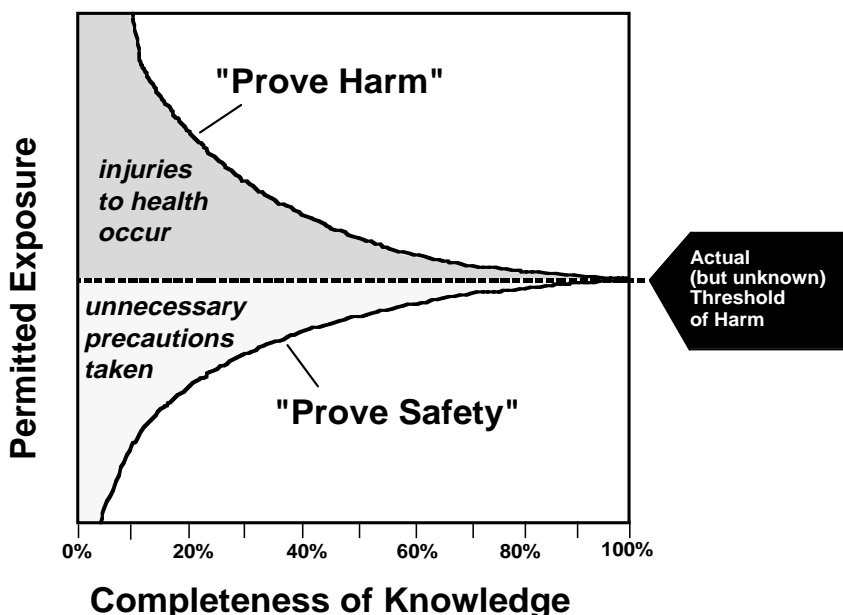
In the absence of public understanding and involvement, critical decisions regarding public health are likely to be dictated by narrow special interests that have as a core concern neither public health nor the welfare of the economy as a whole. These decisions should not be dictated by the special interests that

profit by undermining or resisting safeguards. The role of special interests in the regulation of environmental chemicals is an important matter for public debate, as it has direct relevance to the neurological development of children now and in the future.

### Taking Our Children Back Out Of Harm's Way

We should not need to identify with certainty exactly how much and through what mechanism a neurotoxic pesticide impairs brain development before coming to the conclusion that public health is not protected when the urine of virtually every child in this country contains residues of these chemicals. We can become more discriminate in home use of pesticides and modify agricultural systems so that we rely less on pesticides that are toxic

### Burden of Proof



Consider a substance for which there is some unknown threshold at which harm occurs. At any given state of knowledge, there is an exposure that has been proven to be harmful. This is the upper curve in the figure.

There is also an exposure level for which evidence of safety exists. This is the lower curve in the figure.

If we decide to allow the regulatory process to follow the upper curve, we will allow exposure until proof of harm accumulates. Then the exposure level will be lowered to reflect the new evidence of harm. This approach guarantees that health will be harmed as knowledge is accumulated. If we decide that the regulatory process should follow the lower curve, human health will be protected. As knowledge of toxicity is gained, it may be found that the standards can be relaxed.



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and ubiquitous in the environment. We do not need to exhaustively understand the mechanism by which methylmercury interferes with normal fetal brain development before concluding that it is not acceptable for freshwater and many ocean fish to be sufficiently contaminated with mercury to threaten developing brains. We know how to reduce the environmental releases of mercury so that fish are once again safe to eat regularly. We can modify manufacturing practices so that lead use in products goes steadily down instead of up. We can eliminate or modify outmoded technologies that produce the dioxin that contaminates fetuses and breast milk. We know how to do these things. What is often lacking is the political will to do them.

Though we can do little about genetic contributions to many of these disorders, we have enormous

opportunities to mitigate environmental factors. Fifty years into the post war chemical revolution, sufficient evidence has accumulated to permit better understanding of the hazards of chemical exposure and the costs to human health.

Protecting children from harmful exposures to environmental chemicals is well within our grasp. Residual uncertainties can not be an excuse for inaction when the weight of evidence establishes the likelihood of harm.

Many different disciplines bring their own special expertise to bear on understanding the origins of the developmental disabilities we have discussed. Toxicologists, epidemiologists, behavioral geneticists, psychologists, social workers, teachers, parents, and health care providers each have important roles and responsibilities. We hope this report will help empower them and everyone else who cares about our young and vulnerable to better understand the insidious risks to children's health that result from widespread, repetitive chemical exposures. An informed and motivated public is critical to freeing our public agencies from the influence of financial conflicts of interest. This will permit these agencies to exercise their intended role as guardians of public health and strengthen democratic, participatory decision-making. In so doing, we can restore a margin of safety for our current and future children, and take them back, out of harm's way. ☺