



# Exploring the Environmental Causes of Autism and Learning Disabilities

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# WHAT CAUSES AUTISM AND LEARNING DISABILITIES?

## *THE CASE FOR AN ENVIRONMENTAL CONTRIBUTION*

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# Rates of Autism are Increasing

- Current prevalence in US is 1 case per 110 children
- This is substantially higher than reported prevalence a decade ago

# Genetic Contribution to Autism

*Genetics clearly plays a role*

- 70%+ concordance in identical twins
- Families may contain children with frank autism as well as children with “autistic traits”
- Autism may co-occur with numerous inherited syndromes – Fragile X syndrome, Down syndrome, Cohen syndrome, Angelman syndrome, and Rett syndrome

# Shortcomings of a Purely Genetic Explanation for Causation

- None of the genetic findings accounts for more than 1-3% of cases of autism.
- Taken together, the genetic factors identified to date account for no more than 20-25% of cases
- A purely genetic theory of causation has difficulty in explaining occurrence of sporadic cases, discordant development of autism in identical twins, variations in expression within families, and rise in incidence of autism

These shortcomings, plus an emerging body of data on the vulnerability of the developing brain to external exposures, raise the possibility of an environmental contribution to autism

# Further Support for an Environmental Contribution to Autism:

## NAS report on Environmental Origins of Developmental Disabilities

- 3% of neurodevelopmental disabilities are caused by toxic exposures in the environment
- 25% are caused by interactions of environmental factors (defined broadly) with individual susceptibility factors
- In total, 28% are understood to be of at least partial environmental origin

National Academy of Sciences, 2002

# Plausibility for an Environmental Contribution to Autism: Four Key Arguments

- Evolving knowledge of the vulnerability of the human fetus to toxic chemicals
- Direct evidence that chemicals can cause neurodevelopmental toxicity
- Direct evidence that certain prenatal exposures can cause autism
- Lack of information on the potential neurotoxicity of thousands of widely used synthetic chemicals

# The Exquisite Vulnerability of the Fetus to Toxic Chemicals



- Phocomelia in infants exposed in the womb to thalidomide.
- Cancer of the reproductive organs in girls exposed prenatally to di-ethyl stilbestrol (DES)

These tragic cases destroyed forever the myth of the invulnerable placenta

# Direct evidence that chemicals can cause neurodevelopmental toxicity

First documented at Minamata, Japan

A child massively exposed to mercury in the womb – Minamata, Japan, 1960



No visible damage to the mother

# Minamata showed that the fetal brain is far more vulnerable than the adult brain to industrial chemicals

This vulnerability is a consequence of the brain's extraordinary complexity, and is greatest in early life.

The concept of “**windows of vulnerability**”

# Prenatal Exposures and Autism

*The strongest “proof of principle” for an environmental contribution*

- A small number of environmental exposures are convincingly linked to autism
- Each of these exposures appears to have occurred prenatally, and indeed to have occurred very early in gestation at a time in embryologic development when the fundamental architecture of the brain is being established

# Chemicals and other environmental exposures known to cause autism

- Thalidomide
- Misoprostol
- Prenatal rubella infection
- Valproic acid
- Organophosphate insecticides - chlorpyrifos

# Lack of information on potential toxicity of thousands of synthetic chemicals

- Children today are surrounded by a large and increasing number of chemicals. Some are highly beneficial - e.g., foodstuffs, antibiotics and disinfectants. But others are toxic and known to cause disease
- Measurable levels of several dozen industrial chemicals have been detected in the bodies of nearly all persons in industrially developed countries, including breast milk and cord blood of newborn infants
- 80% of the most widely used chemicals have never been tested for possible toxicity to early development

# Chemicals currently known to cause injury to the developing brain

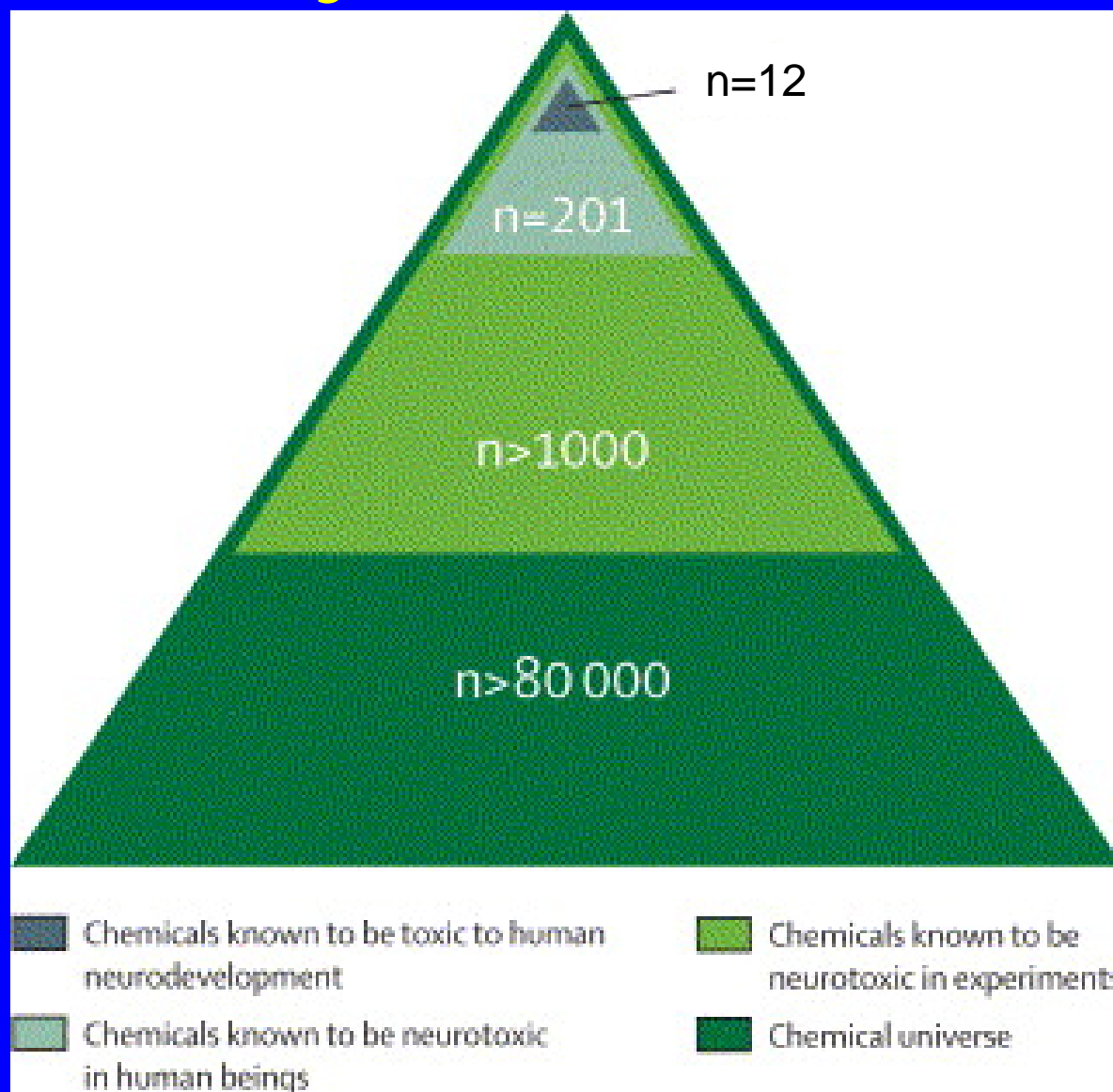
- Lead
- Methyl Mercury
- Polychlorinated Biphenyls (PCBs)
- Arsenic
- Manganese
- Organic solvents, e.g., Ethanol and Toluene
- Organophosphate pesticides - Chlorpyrifos
- Organochlorine pesticides
- Phthalates
- PBDEs

➤ *Another 201 industrial chemicals are known to cause neurotoxicity in adults, but developmental toxicity is untested.*

➤ *An additional 1,000 are neurotoxic in animal species*

➤ *Are there other chemical causes of autism?*

# Are there other chemical causes of autism not yet discovered?

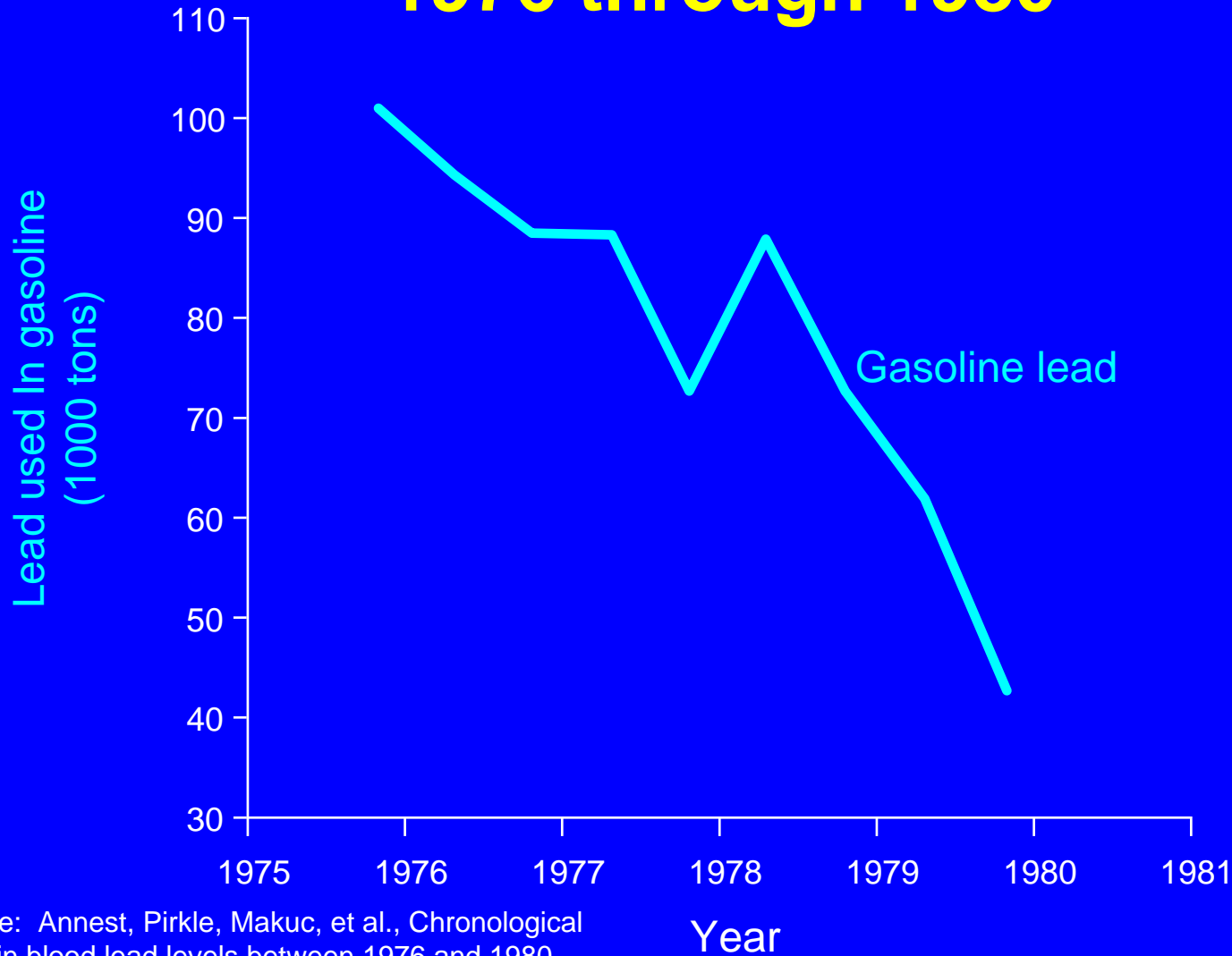


# The Good News: Progress is Possible

*Studies showing environmental harm to children are powerful drivers of progress*

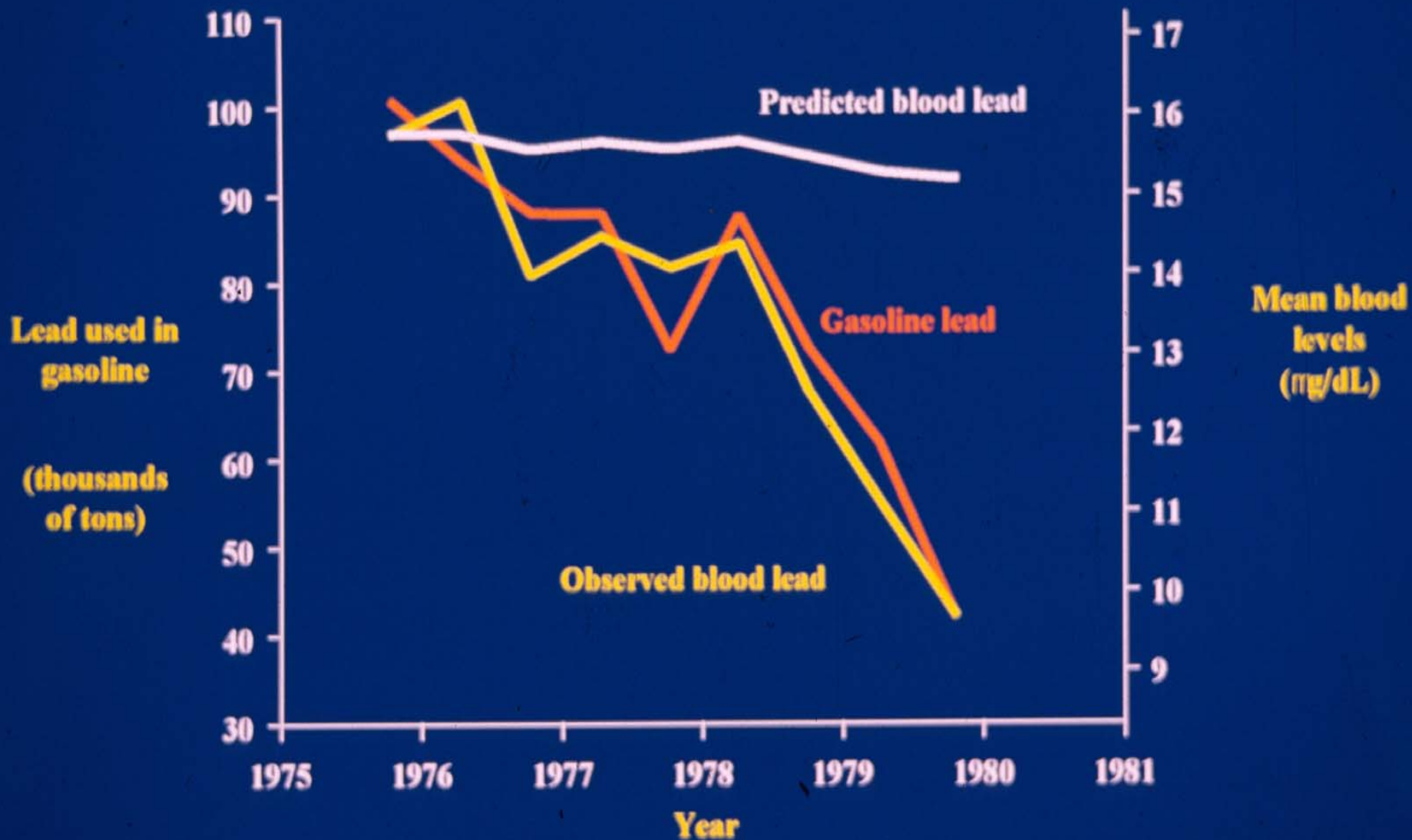
Removal of lead from gasoline as a case study

# Lead use in gasoline in USA declined from 1976 through 1980



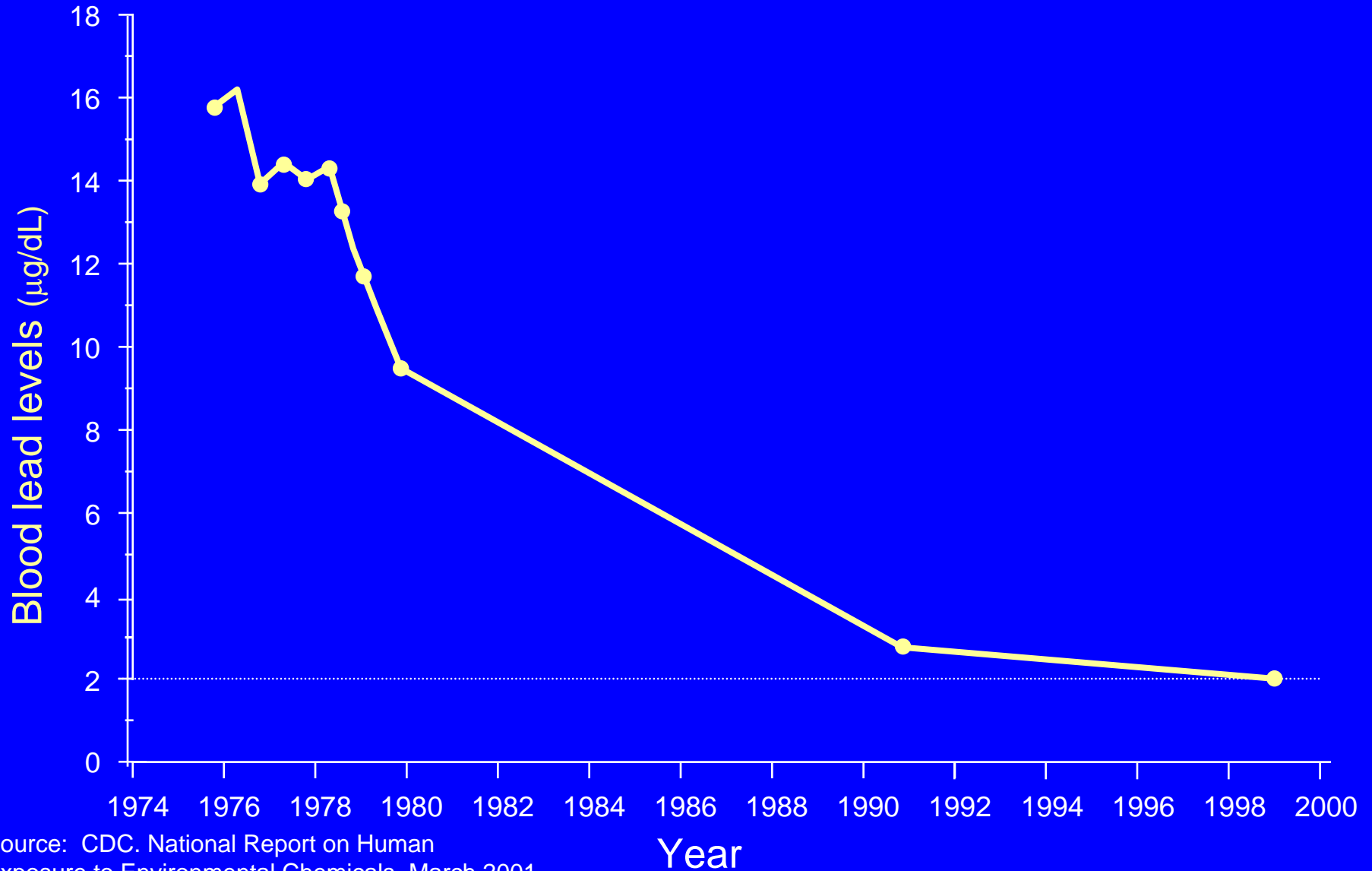
Source: Annest, Pirkle, Makuc, et al., Chronological trend in blood lead levels between 1976 and 1980. NEJM 1983; 308;1373-7.

# The EPA Decision on Lead in Gasoline: Decline in Blood Lead Levels Greatly Exceeded Expectation



# Blood lead levels in the U.S. population 1976 -1999

NHANES II, III, 99+



Source: CDC. National Report on Human Exposure to Environmental Chemicals, March 2001

# Plan of the Day

- Morning: Review of US and European research relevant to environmental causation of autism
- Afternoon: Review of relevant resources at Mount Sinai School of Medicine
- Finale: A plan for the future

# Thank you

- Mount Sinai School of Medicine
- Our Executive Board in the Children's Environmental Health Center
- Autism Speaks
- All of our speakers and participants



*Protecting Children against  
Environmental Threats to Health*



WHO Collaborating Centre in Children's Environmental Health