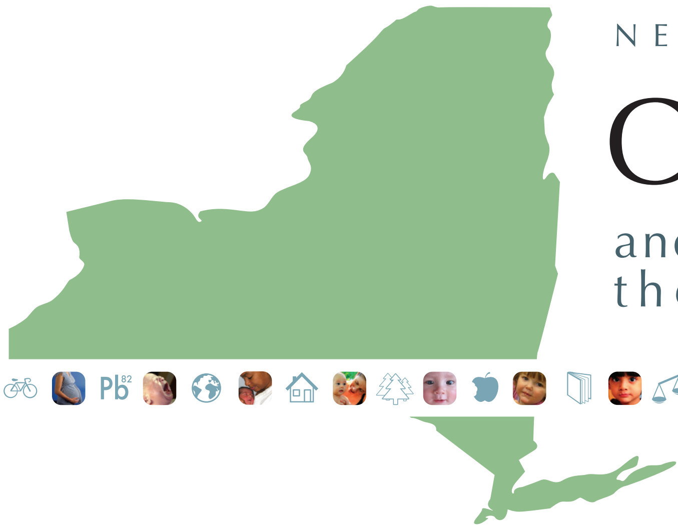

NEW YORK STATE'S

Children and the Environment

A Report from the

Children's Environmental Health Center

Icahn School of Medicine at Mount Sinai

December, 2013

Mount Sinai

Children's Environmental Health Center

This report was prepared by the Children's Environmental Health Center of the Icahn School of Medicine at Mount Sinai.

The mission of the Mount Sinai Children's Environmental Health Center is to discover the environmental causes of disease in children and to translate scientific research into public policies and practical solutions that protect children's health. The Center has strong educational programs that are training the next generation of researchers and clinical leaders in environmental pediatrics. We have published a major Textbook in Children's Environmental Health. The Center supports educational programs for parents, the general public and policy makers. In partnership with Mount Sinai's Department of Pediatric, the Center provides diagnostic and treatment services to children who have been exposed to health threats in the environment or who suffer from diseases suspected to be of toxic environmental origin.

The Director of the Mount Sinai Children's Environmental Health Center is Philip J. Landrigan, MD, MSc, FAAP. Dr. Landrigan is Ethel H. Wise Professor and Chairman of the Department of Preventive Medicine, Professor of Pediatrics and Dean for Global health at Mount Sinai. The Center's Deputy Director is Robert O. Wright, MD, MPH, FAAP, Professor of Preventive Medicine and Pediatrics and Vice-Chair of the Department of Preventive Medicine. Ms Katherine Southwick is the Center's Program Manager.

This report was prepared by Philip J. Landrigan, MD, MSc, FAAP; Geoffrey "Cappy" Collins, MD, Fellow in Environmental Pediatrics; Maida Galvez, MD, MPH, FAAP, Associate Professor of Preventive Medicine and Pediatrics; Perry Sheffield, MD, MPH, FAAP, Assistant Professor of Preventive Medicine and Pediatrics; and Joel Forman, MD, MPH, FAAP, Vice-Chair of Mount Sinai's Department of Pediatrics. Ms. Laura Wallis; Mr. Colin Raelson; Fabian Engelbertz, MD; and Mr. Calvin Jara provided editorial assistance.

Table of Contents

Executive Summary 1

Conclusions 3

Recommendations 4

Ch 1. New York State's Children—A Demographic Profile 5

Ch. 2. The Unique Vulnerabilities of Children 7

Ch. 3. Diseases of Environmental Origin in New York State Children 10

Ch. 4. Environmental Hazards Confronting New York's Children 28

Ch. 5. Schools—Where Children Learn and Play 57

Ch. 6. Prevention of Environmental Disease 61

Ch. 7. Economic Costs of Environmental Disease in Children 62

Ch. 8. Medical Resources and Support Services for Children with Disease of Environmental Origin 67

Ch. 9. New York State Department of Health Programs in Children's Enivromental Health 71

Ch. 10. NYS Department of Environmental Conservation Programs in Children's Enivromental Health 75

Ch. 11. NYS Department of Education Conservation Programs in Children's Enivromental Health 78

Executive Summary

The children of New York today live longer, healthier lives than the children of 50 or 100 years ago. Thanks to safe drinking water, environmental improvements, vaccines and antibiotics, the ancient infectious diseases that were once the great scourges of childhood have now largely been controlled. Infant mortality has declined by over 90%. Children's life expectancy has doubled.

Despite these great gains, children in New York suffer today from a wide array of chronic diseases. Many of these diseases are on the rise. Evidence is strong and growing that environmental factors contribute to them.

ASTHMA has tripled in the past three decades and become the leading cause of emergency room visits, hospitalizations and school absenteeism. It affects 250,000 New York children and is especially common among minority children. Air pollutants, mold and cigarette smoke all contribute to childhood asthma.

BIRTH DEFECTS are now the leading cause of infant death. Certain birth defects, such as hypospadias, have doubled in frequency.

DEVELOPMENTAL DISORDERS such as ADHD, dyslexia and learning disabilities affect one of every six American children. Autism has increased sharply in prevalence and now afflicts one child in 88.

PRIMARY BRAIN CANCER among children has increased in incidence by nearly 40% from 1975 to 2004, according to the National Cancer Institute.

CHILDHOOD LEUKEMIA has increased in incidence by over 40%. Benzene, other solvents and pesticides are linked.

CHILDHOOD OBESITY has nearly quadrupled in the past ten years, and its sequel, Type 2 diabetes, previously unknown among children is becoming epidemic.

LEAD POISONING affects more than 2,200 children in New York State each year. Even at low levels, lead causes brain damage with loss of intelligence, disruption of behavior and shortened attention span.

Toxic and Untested Chemicals: Children in New York today are at risk of exposure to more than 80,000 synthetic chemicals. Most of these are new chemicals that did not exist 50 years ago. The Centers for Disease Control and Prevention (CDC) finds measurable levels of scores of new synthetic chemicals in the bodies of virtually all Americans.

A high proportion of the most widely used chemicals have never been tested for safety. Information on possible health effects is not available for half of the most widely manufactured chemicals. Information on developmental toxicity to infants and children is not available for 80%.

Scientific evidence is strong and continuing to build that toxic chemicals and other hazards in the modern environment are important causes of diseases in children. According to the World Health Organization, environmental exposures are responsible for 35% of all childhood disease and deaths worldwide. Indoor and outdoor air pollution are now established as causes of asthma. Childhood cancer is linked to solvents, pesticides, and radiation. The National Academy of Sciences has determined that environmental factors contribute to 28% of developmental disorders. The urban built environment and the modern food environment are important causes of obesity and diabetes.

Economic Costs of Environmental Disease: Diseases caused by toxic chemicals impose great economic burdens on families, schools, communities, health care providers and society. These diseases are enormously expensive. A recent analysis estimates that the costs of disease of environmental origin in New York's children amount to $4.35 billion each year. These costs fall on the families of sick children and also on New York's taxpayers by unnecessarily increasing the annual Medicaid budget for and the budgets special education and other programs for children who have been damaged by exposures in the environment.

Prevention of Environmental Disease: Diseases in children caused by toxic chemicals and other hazards in the environment can be prevented. These diseases can be prevented when their causes are known. Scientific research provides the evidence-based blueprints we need to discover the causes of disease and to protect children from environmental threats to health. Disease prevention saves lives, enhances children's lives, reduces health care and education costs and increases productivity.

The savings that result from disease prevention can amount to tens of billions of dollars each year. An extraordinarily successful example of evidence-based prevention is the removal of lead from gasoline. This action, taken by US EPA in 1976, was triggered by the discovery that lead can cause brain injury in young children. The removal of lead from gasoline lowered US children's blood lead levels by more than 90%, reduced lead poisoning by more than 90% and raised the average IQ of American children by 2-4 points. Additionally it has produced an economic benefit of about $200 billion each year since 1980. This benefit is largely the result of the increase in national productivity that followed widespread increases in children's IQ.

Current Resources in Environmental Pediatrics: Pediatricians in New York State report they are not comfortable managing environmental aspects of disease, despite the high prevalence of these problems. Only 19.4% New York State pediatricians been trained to suspect the environment as a cause of disease in children. The four-year curriculum of the average American medical school devotes only six hours' teaching time to topics in environmental health. Most physicians do not routinely obtain histories of environmental exposure from children and their families. And because there is currently only one Center of Excellence in Children's Environmental Health in all of New York State, located at Mount Sinai Medical Center in Manhattan, pediatricians, family physicians and other health care providers in most areas of New York have nowhere to refer children who have become ill from environmental exposures.

Conclusions

The Mount Sinai Children's Environmental Health Center has reached the following conclusions through this analysis of New York State's Children and the Environment:

Children in New York suffer today from a wide array of chronic diseases. Many of these diseases are on the rise.

Scientific evidence is strong and continuing to build that toxic chemicals and other hazards in the modern environment are important causes of diseases in children.

The costs of diseases of environmental origin in the children of New York amount to about $4.35 billion each year.

Diseases of environmental origin in children are preventable. Prevention of these diseases will improve children's lives and has the potential to generate enormous cost savings.

Prevention and treatment of disease of environmental origin in New York's children requires creation of a statewide network of Centers of Excellence in Children's Environmental Health

Recommendations

To improve the prevention and treatment of disease of environmental origin in New York's children, the Mount Sinai Children's Environmental Health Center recommends the creation of a statewide network of Centers of Excellence in Children's Environmental Health. This network should be funded on a permanent and sustainable basis and coordinated through the New York State Department of Health.

The Centers of Excellence that comprise the network should be distributed geographically across the State. To the extent possible, they should be co-located and work in partnership with the highly successful statewide network of Centers of Excellence in Occupational Health and Safety that was established in 1988. This network has diagnosed and treated tens of thousands of adult patients since its formation, has seen a sharp drop in occupational diseases and injuries in New York State over the past 25 years, and was critical in the medical responses to 9/11 and Hurricane Sandy.

This network of Centers of Excellence will provide expert diagnosis and treatment for children across New York who have sustained toxic exposures in the environment or are suffering from diseases suspected to be of environmental origin.

The Centers will serve as sources of specialty referral and consultation for pediatricians, family physicians and other health care providers across New York State. The Centers will educate children, parents, teachers, children's agencies, policy-makers and the public in their regions of New York State about environmental threats to children's health and will empower New Yorkers in all regions of the State to take action against environmental hazards.

Each Center will be comprised of a team of pediatricians, nurses, social workers and health educators who provide a range of services: evidence-based guidance on questions pertaining to environmental factors and children's health; educational outreach; timely messaging on acute health events; and collaboration on community-level issues involving multiple stakeholders.

The network of Centers of Excellence in Children's Environmental Health will work together across New York State, to improve the health of children through research, advocacy and prevention.

New York State's Children — A Demographic Profile

According to the 2010 census, there are approximately 4,313,756 children under age 18 currently residing in New York State (22.2% of the State's total population) (1). Approximately 1,163,580 of those children (6.0% of the total population) are under the age of 5 (2). Of the state's total population of children, 50.9% are white (non-Hispanic); 17.7% black; 22.6% Hispanic; 6.8% Asian; 0.4% Native American; and 4.6% report two or more races (2).

Roughly 240,000 babies are born in New York State each year (3). According to America's Health Rankings (compiled by the United Health Foundation) for 2009, the state currently boasts a relatively low infant mortality rate, at 5.1 deaths per 1,000 live births, trending down from 5.4 per 1,000 in the last four years (4). However, this encouraging improvement belies a stark health disparity: the infant mortality rate among black infants is 2.7 times higher than white infants, which has trended up from 1.8 times the risk in the same period (5).

In the year 2007, there were 2138 deaths of children aged 0-19 in the state (6).

Some 22.6% of the state's children (nearly 900,000 children) are living below the poverty line (7). New York is ranked near the bottom (39th) for state high school graduation rate, with only 73.5% percent of incoming ninth graders graduating within four years (8). New York also ranks lower for health determinants than for health outcomes, indicating that overall healthiness may decline over time (5).

Approximately 15%, or 660,565, of New York State's children, between the ages of 0 and 17 have special health care needs, according to a 2009-2010 National Survey of Children with Special Health Care Needs (9). Due to developmental delays and behavioral patterns, children with special needs are especially vulnerable to the risks posed by environmental hazards.

Ideally, the home is a nurturing environment that protects against disease; however, there are home-based environmental exposures that are deleterious to children's health. 19.4% of NYS children live in a home where someone smokes (17). Smoke exposure is correlated strongly with asthma symptoms and other respiratory disease in children (10) 59.3 % of NYS children have experienced at least one Adverse Childhood Experiences (ACE's) (11). ACE's, such as forms of neglect and abuse, are correlated with poor academic achievement and multiple poor health outcomes in adulthood, including depression, strokes, heart disease, and multiple forms of cancer (12). Two or more ACE's drastically increase the risk of these problems; 17.7% of New York State children are in this category (10).

Obesity rates remain high in New York State. Based on Department of Health data from 2010-2012 33.8% of public school students (exclusive of NYC) are overweight or obese (13). This represents a slight improvement from past years; however, impoverished children are bearing the greatest burden: they are nearly twice as likely to be obese (22% compared to 12.7%) (14).

According to the New York State cancer registry, between 2006-2010, approximately 125 children ages 0-19 years in New York died each year from cancer (15). There were approximately 943 annual cases of invasive malignant tumors in children during that time (16).

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The Unique Vulnerabilities of Children

Children are exquisitely vulnerable to injury and disease caused by hazards in the environment. Exposures that occur during the nine months of pregnancy and in the earliest months and years of childhood are of greatest concern. The National Academy of Sciences studied the issue of children's unique sensitivity to toxic chemicals in the environment and issued a landmark report in 1993. This analysis found five fundamental differences between children and adults that account for children's extraordinary vulnerability to health and safety hazards in the environment.

1 **Greater Exposures** Pound for pound, children's physiology exposes them to disproportionately greater amounts of toxic chemicals and other environmental hazards. In part, the difference reflects children's disproportionately heavy consumption of food, water and air. Specifically, an infant in the first year of life eats two-and-a-half times as many calories (1), drinks five times as much water (1), and brea hree times as much air per pound of body weight compared to an adult (2). In other words, the infant's normal growth demands consumption of many times the proportional amounts of toxins as an adult who drinks, eats and breathes respective water, food and air of the same quality.

2 **Unique Behaviors** Children have age-specific behaviors that adults do not have. Their short stature and ground-level activities (learning to crawl, walk and play) expose them to inhaled gaseous and particulate matter toxins that are heavier than air. Their developmentally appropriate hand-to-mouth behavior intrinsically puts them at risk for extra consumption of toxins in dust and soil on floor/ground surfaces, and for ingesting toxins used in everyday household items that find their way to children's mouths: e.g. plastics, heavy metals, pesticides, flame retardants, et al.

3 **Immature Metabolism** Children's metabolic pathways, especially in the first months after birth, are immature. In many instances, children are less able than adults to break down and excrete toxic compounds. The CPDIC, focusing on the data we have on pesticide studies in animals, concluded that "current testing protocols do not, for the most part, adequately address the toxicity and metabolism of pesticides in neonates and adolescent animals or the effects of exposure during early developmental stages and their sequelae in later life (1). Since we have a paucity of direct data on the effects of toxicants on humans, and even less on children, the general recommendation is to be more cautious of chemical levels by orders of magnitude.

4 **Rapid Growth and Development** An infant typically doubles its weight by six months of age, and triples by one year. The developmental processes that are proceeding in an extraordinarily rapid rate in young children both before and after birth are very complex and easily disrupted by toxic exposures. Early development creates windows of exquisite vulnerability, as was illustrated by the tragic consequences of exposures in prenatal life to thalidomide, DES and methylmercury (3-5).

Early development of the human brain is especially complex. During the nine months of pregnancy, the developing brain must evolve from a strip of cells along the back of the embryo into a complex organ consisting of billions of precisely located, highly interconnected and specialized cells. Optimum brain development requires that neurons move along exact pathways from their points of origin to their assigned locations, that they establish connections with other cells, both nearby and distant, and that they learn to communicate with other cells via these connections. All of these processes must take place within tightly controlled time frames, in which each developmental stage has to be reached on schedule and in the correct sequence. Because of the extraordinary complexity of human brain development, windows of susceptibility to toxic interference arise that have no counterpart in the mature brain. If a developmental process in the brain is halted or inhibited by a chemical such as lead, methylmercury or a pesticide, the consequences can be permanent, irreversible and untreatable. Prevention of exposures is therefore of critical importance.

Similar considerations pertain to development of the heart and cardiovascular system, the immune system, the reproductive organs and other organ systems. Early exposures to even very low levels of toxic chemicals can have devastating effects. Prevention of exposure is of paramount importance.

5 **Long Future Life** Because children have more years of future life than most adults, they have more time to develop chronic diseases that may be initiated by early exposures. Many diseases caused by toxic agents in the environment require decades to develop. Cancer and neurodegenerative diseases, for example, are thought to arise through a series of changes within cells that require many years to evolve from initiation to actual manifestation of illness. Exposures to environmental agents early in life, including prenatal exposures, appear more likely to produce chronic disease than similar exposures encountered later (1).

Policy Implications

In 2006, the World Health Organization published a report, revealing that as much as 24% of global disease is caused by avoidable environmental exposures (7). More significantly, 35% of disease in children under five years old is caused by environmental hazards. Most worrisome is the finding that "among children 0–14 years of age, the proportion of deaths attributed to the environment was as high as 36%" (7).

Despite their unique vulnerabilities, children are not currently protected from toxic exposures. In fact, children bear a significantly greater body burden of toxic environmental chemicals than adults. For example, the Centers for Disease Control and Prevention's *Second National Report on Human Exposure to Environmental Chemicals* found that body burdens of the commonly used pesticide chlorpyrifos were twice as great in children compared with adults (6). The National Academy of Sciences stated unequivocally that, "In the absence of data to the contrary, there should be a presumption of greater toxicity to infants and children," requiring greater action to diagnose environmental disease and decrease the threats(1).

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Diseases of Environmental Origin in New York State Children

Children's health has health has improved remarkably in New York and across the United States since the 19th century. These improvements are unprecedented in human history. Despite AIDS, SARS, West Nile virus and the constant threat of other emerging infections, the ancient epidemics of smallpox, yellow fever, cholera, bubonic plague, polio and measles are no longer the dominant causes of disease and death.

Since 1907, mortality for young children (ages 1-4 years) in the U.S. dropped by 98%—from 1,400 to just 28.6 deaths per 100,000 children (1). At the beginning of the 20th century, almost 1 in 6 children died before his or her first birthday, largely from infectious diseases caused by urban crowding, and contaminated food and water (2). Today we are approaching just 6 per 1000 (3). Life expectancy has roughly doubled from about 40 years in the 1850's (4) to 78.7 years in 2010 (3), largely because of the public health measures that improved the survival of children.

These public health milestones addressed the predominant environmental hazards of the day: safe drinking water; the provision of sufficient, wholesome food; the removal of sewage; the control of insect vectors; and the construction of decent housing. In New York, the decline in mortality that marked the start of the epidemiological transition (5) began in the 1860s, soon after construction of the Croton Aqueduct.

Today, children in New York state confront a different set of chronic and debilitating diseases. Despite medical advances, these diseases are pervasive and difficult to treat: asthma, birth defects, cancer (which is the second leading cause of death in children after injuries), developmental disabilities and autism, and obesity. Many of these diseases are on the rise. And many of them disproportionally affect minority groups and children in poverty—the same children bearing the greatest burden of environmental health hazards. As in the past, environmental factors are major contributors; unlike the past, the environmental solutions have not been adequately addressed. [For references, see individual section discussions, below.]

Asthma rates have tripled in the past three decades to become the leading cause of emergency room visits, hospitalizations and school absenteeism. Asthma is especially common among minority children and children living in poverty. Air pollutants, mold and cigarette smoke are all major contributors.

Birth defects are now the leading cause of infant death. Certain birth defects, such as hypospadias, have increased sharply in frequency. Phthalates, as one example, are a common class of chemicals in consumer products that are correlated with hypospadias and other abnormalities. Prematurity is another perinatal concern: preterm birth has increased across the U.S. by 24% from 1981 to 2011; multiple environmental toxicants, including various pesticides, air pollutants and heavy metals, are strongly associated.

Cancers. Leukemia, brain cancer in children, and testicular cancers in adolescents and young men have increased in incidence since the 1970s. In 2011, cancer surpassed traumatic injuries to become the leading cause of death in New York's children ages 5-14 years, and is the second leading cause in children ages 1-19 overall.

Developmental and behavioral disorders. Conditions such as learning disabilities (including dyslexia), intellectual disabilty, attention deficit/ hyperactivity disorder (ADHD) and autism affect about 10% of children aged 2-17. 28% percent of these neurobehavioral disorders are due to direct toxic environmental exposures or combinations of exposures with genetic susceptibility. Psychiatric disorders are also implicated.

Obesity has quadrupled for young children in the last ten years; its sequel, type 2 diabetes, is now epidemic in New York's children. Obesity is correlated with a variety of endocrine disrupting chemicals commonly found in consumer products.

There is no question that environmental toxicants contribute to diseases in children. Indoor and outdoor air carries pollution in the forms of particulate matter, allergens, products of fuel combustion, tobacco smoke and flame retardants; dust and soil contain lead, phthalates and polychlorinated biphenyls (PCBs); food and water contain arsenic, mercury, pesticides and dozens of other synthetic chemicals. What's needed are the resources to protect children from known harms, trained health care providers to treat the existing environmental disease, and research to identify the unknown harms.

Asthma

From 1980 to the mid-1990s, the prevalence of childhood asthma more than doubled nationwide and in New York. Although the rates have begun to stabilize since then, they remain at historically high levels, and ambulatory care and hospitalizations for asthmatic children have continued to increase (6).

Both outdoor and indoor air pollution are implicated in causation of new cases of asthma and also in triggering acute asthma attacks. Ambient air pollutants, especially ground-level ozone and fine particulates of automotive origin, have been shown to be important triggers of acute asthma (7, 8). The frequency of asthma attacks increases when the severity of pollution increases and declines when levels of pollutants drop (9).

Indoor air pollutants linked to asthma include secondhand tobacco smoke, nitrogen dioxide, pesticides, molds, and volatile organic compounds (10). Vermin (especially cockroaches), pet dander, and dust mites are all asthma triggers commonly founding the home and school environments (11, 12). In its 2000 report entitled "Clearing the Air: Asthma and Indoor Air Exposures," the National Research Council

NYS Snapshot

475,000 NYS children had asthma in 2008 (13)

Asthma caused an average of 255 deaths per year in New York during 2005-2007, including 31 deaths of children 0-14 years old (13)

The statewide prevalence rates of asthma in New York have been higher than the national average since 2002 (13)

27% of New York City children visited the emergency department for their asthma in 2006-7. This is almost 5 times higher than children in the rest of the state (13)

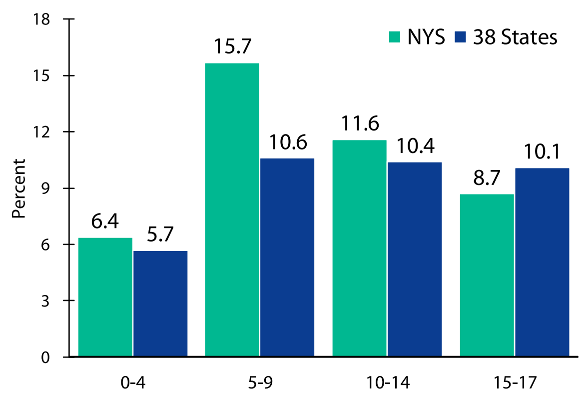
Racial/ethnic disparities exist: 2006-2008 prevalence of the disease is higher for black children (17.3%) than for Hispanic (11.1%) and white (8.7%) children (13)

Asthma has become the leading cause of hospital admission for New York's children. Children aged 0-14 years had 40,780 admissions between 2005 to 2007, costing $317,832,261 (13) [Calculations by author]

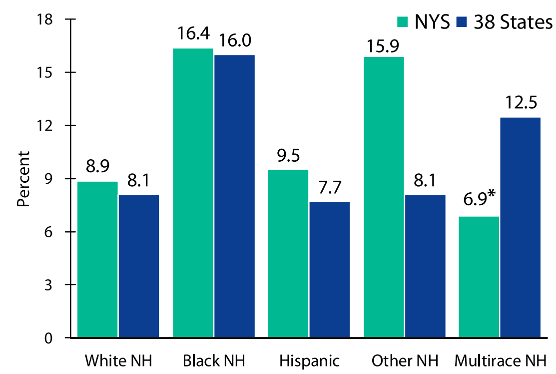
Figure 3.1. Children and Asthma in New York

In 2008, an estimated 475,303 children in New York State had asthma. Child lifetime asthma prevalence was 16.1% and child current asthma prevalence was 10.8% compared with the 38 participating states' rates of 13.3% and 9.0%, respectively.

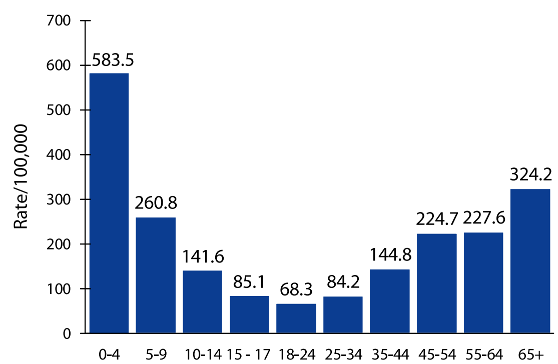
Child Current Asthma Prevalence by Age, 2008



Child Current Asthma Prevalence by Race/Ethnicity, 2008



Asthma Hospitalizations



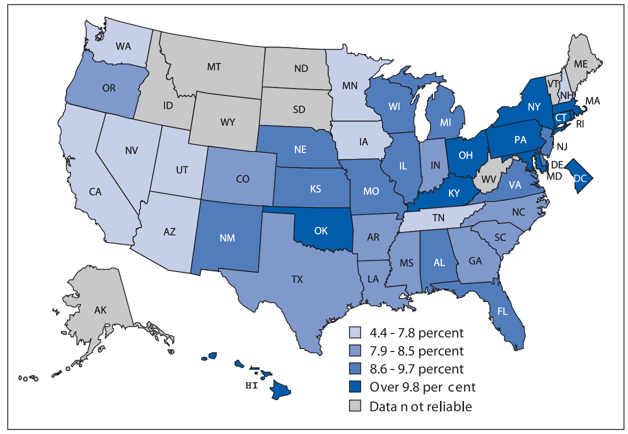
Source:
CDC State Data Profiles (2011)
Asthma in New York State
Retrieved Nov 20, 2013 from
http://www.cdc.gov/asthma/stateprofiles.htm

(NRC) found sufficient evidence to conclude a causal relationship between exposure to the allergens produced by cats, cockroaches, and house dust mites and exacerbations of asthma in sensitized children (14). This report also found a causal relationship between exposure to environmental tobacco smoke and exacerbations of asthma in preschool children, as well as an association between exposure to allergens produced by mold and dogs and exacerbations of asthma in sensitized children.

According to the NRC report, a combination of home improvement methods, such as installation of improved air filtration systems and removal of old carpeting, can successfully reduce the levels of dust mite allergens; likewise, combining cockroach extermination and control of potential allergen reservoirs can reduce the levels of cockroach allergens in home environments. While the report found less evidence to link home environmental improvement measures and improvement of symptoms or lung function in children, the report found this link to be inadequately studied, and suggested both the need for further study and the potential for this research to improve public health significantly (14).

The school environment poses significant risks for asthma prone children. Pollutants in schools such as emissions from industrial carpeting, pesticides, cleaning chemicals, molds, and diesel exhaust from school buses all contribute to asthma in school children (10). Diesel emissions are a major contributor to the high rates of asthma symptoms among school-age children. In a recent, five-year study by researchers at New York University's School of Medicine and Robert F. Wagner Graduate School of Public Service, asthma symptoms, particularly wheezing, were found to double among elementary school children on high traffic days. Large numbers of those children attended schools near busy truck routes (15).

Figure 3.2. U.S. Asthma Rates



Source:
Akinbami L. (2006). "The state of childhood asthma, United States, 1980-2005". Advance data from vital and health statistics of the National Center for Health Statistics.

An second NRC report (16) recommended that school buildings be deliberately designed to provide healthful indoor learning environments. A separate study (17) found that healthy indoor environments in schools could substantially reduce incidence of asthma and upper respiratory illnesses and that the health benefits far outweighed benefits accruing from conventional energy or water conservation measures in new building design.

A New York State Department of Health (NYSDOH) study, "Asthma and the School Environment in New York State," (18) reported that "…many environmental asthma triggers and the conditions that promote them are common in elementary schools. Almost all (99%) schools reported dust or reservoirs of dust in classrooms, 84% reported mold or moisture problems, 42% reported potential exposure to diesel exhaust, and 40% reported pets in at least one classroom. In addition, some policies and practices designed to improve school IAQ are not being implemented in the majority of schools, including anti-idling policies to limit diesel pollution, and airing out of new carpets and use of green-rated cleaning products to limit pollution from chemical contaminants. Formal IAQ programs were reported in only a quarter of these schools … suggesting a possible disconnect between implementation of policies at the school and district levels."

NYS Snapshot

In 2008, a major congenital malformation was reported in 5.1% of live births in New York State (20)

An estimated $270 million is spent each year in New York on medical care and support services for individuals with birth defects (27, 28) [Calculations by author]

Preterm births cost $26.2 billion in the US in 2005 (29), or $51,600/infant (30). With 29,883 preterm infants born in NYS in 2005 (31) that amounts to $1,541,962,800 in one year alone [Calculations by author]

Birth Outcomes

Congenital Malformations and Preterm Birth

Birth defects are the leading cause of infant mortality across the United States (3) and the second leading cause in New York State after perinatal complications (19). Of the four million babies born in the United States every year, approximately 150,000 will have some kind of birth defect (20). Some of these defects are increasingly common. For example, defects of the male reproductive system, such as undescended testicles and hypospadias, doubled in the U.S. from 1970 to 1993 (21).

NYS Snapshot

About one in every six children born in New York—over 660,000 children total—has a developmental disability (42)

6.8% of children ages 2 to 17 in New York State were identified as currently having ADHD in 2007 (10)

Approximately 2.8 million New Yorkers of all ages have some type of learning disability (10)

1 in 88 children is now diagnosed with an autism spectrum disorder (42). In New York State, over 56,000 children are currently diagnosed (43)

According to a 2007 report by the New York State Assembly Committee on Mental Health, Mental Retardation and Developmental Disabilities, there has been a seven hundred percent increase in the number of children in New York State diagnosed with autism since 1992 (44)

Birth defects, also known as congenital malformations, comprise a wide array of anomalies representing severe malformations to organs systems that compromise healthy function. These are intrinsically problems that occur during pregnancy; as such, the quality of the of the mother's environment is directly implicated. While there is no single cause to all birth defects, genetics plays a role, as does poor nutrition (in particular, a lack of folic acid), and infections are sometimes to blame. Additionally, it is clear that environmental factors can play a significant role. The role of alcohol, cigarette smoke, prescription and illegal drugs, and heavy metals, such as lead and mercury are well established. Further, there is mounting evidence implicating certain pesticides, solvents, plastics and even climate change are crucial factors in the increasing incidence of these debilitating outcomes.

Esophageal atresia (closure of the esophagus, such that food cannot pass to the stomach) and diaphragmatic hernia (protrusion of the intestines into the chest cavity) have been linked to not just alcohol consumption, but exposure to herbicides and pesticides (22).

Genital anomalies in boys, including malformation or absence of the testes, and hypospadias (displacement of the urethral opening of the penis) have been correlated with phthalates, pesticides and flame retardants (23).

Heart defects include problems with the chambers of the heart, the septal walls dividing the chambers, the valves and the blood vessels. Petroleum-based solvents, and solvents containing chlorine have been correlated with all these defects (24).

The NYSDOH conducted a review of its New York State Congenital Malformations Registry which revealed evidence that the higher temperatures associated with climate change may be correlated with congenital cataracts, and possibly also renal agenesis and hypoplasia (absent or underdeveloped kidneys) (25).

On the positive side, as the World Health Organization states in a 2010 report, "most birth defects of environmental origin can be prevented by public health approaches, including...legislation controlling management of toxic chemicals.” (26)

Preterm Birth is similarly linked to multiple environmental factors. Preterm birth is important not just because it is a leading cause of death in the first month of life (32), but because it is associated with other developmental problems such as cerebral palsy, impaired learning, pulmonary dysfunction, and hearing and visual disorders (33). Smoking is the most well-known environmental contributor to preterm birth, and there are several other chemical culprits.More recently, the roles of toxic stress, and the social, economic and neighborhood environments have been delineated.

Along with environmental tobacco smoke (ETS), chemicals of concern include persistent organic pollutants such as dichlorodiphenyldichloroethylene (DDE) and perfluorinated compounds (PFCs), and another class called polyaromatic hydrocarbons (PAHs), which are byproducts of fuel combustion (34).

Poor quality air, as measured by the amount of particulate matter (PM), nitrogen oxide species, sufur dioxide, and other products of fuel combustion is strongly correlated with preterm labor (35).

One risk factor for preterm birth is fetal stress, as mediated by hormonal signaling and inflammation. It should be no surprise that the environmental stresses on the mother are implicated in increasing preterm births. Separate researchers have found that in utero stress (36) and neighborhood disorder and racial discrimination (37), and poor housing conditions (38) are all associated with preterm birth. Poverty itself is also a risk factor (34).

Like birth defects, preterm birth also appears to be correlated with higher ambient temperatures (39), which could become an increasingly greater problem with the effects of climate change.

Cancer

Childhood cancer, although relatively rare, is the leading cause of disease-related death among children in New York from infancy to age 15. In 2012, approximately 12,060 new cancer cases were diagnosed among children 14 and younger nationwide, and cancer rates have been slowly trending upward since 1975 (40). Cancers are the leading cause of death in New York’s children ages 5-14 (41).

Among major childhood cancers, the most common are leukemias and primary brain cancers. Together, these comprise more than half of all new pediatric cancer cases(42).

Although cancer mortality rates are down as a consequence of early detection and vastly improved treatment, data from the National Cancer Institute show that the incidence rates of most childhood cancers have increased in the United States over the past three decades (43).

According to data collected by the National Cancer Institute, the incidence of acute lymphocytic leukemia (ALL) increased by 73% and iprimary brain cancer increased 70% percent from 1975 through 2010 among children aged 0-14 years (43). Testicular cancer incidence in adolescents

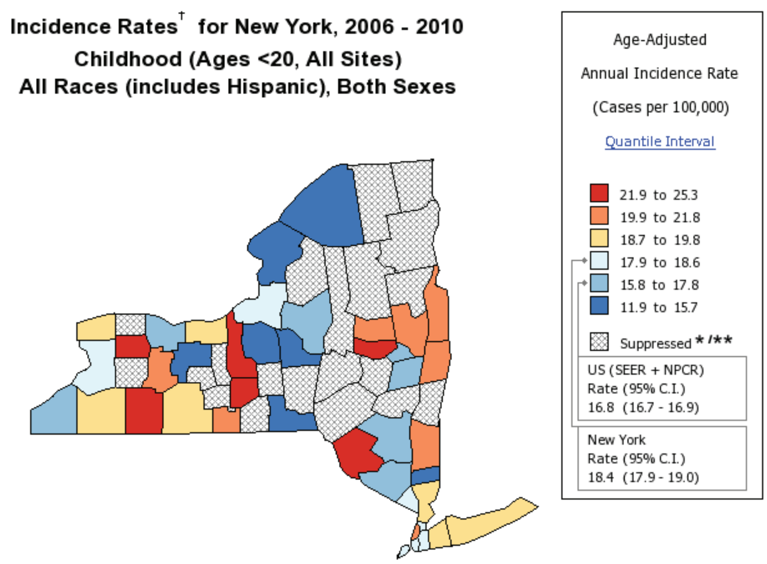
NYS Snapshot

New York State cancer registry data indicate that 943 children 0-19 years of age were diagnosed with cancer each year from 2006-2010, for a total of 4715 children. In the same period, 135 children died from cancer (44) and young men has increased by 57% in the same period of time (45).

The consequences of pediatric cancer extend far beyond childhood. A landmark follow-up study of nearly 10,400 childhood cancer survivors, published in the New England Journal of Medicine in 2006, concluded that many young adults who had conquered cancer as children go on in later life to suffer chronic heath issues such as osteoporosis, hearing loss, thyroid problems, second cancer and heart damage. More than one in four has a potentially life-threatening condition (46).

Childhood cancers comprise a wide range of neoplasms in various tissue types. There is no single cause for cancer; rather, cancer arises from a complex interaction of genetic susceptibility with external factors. Asbestos and tobacco smoke's drastic roles in lung cancer are obvious examples, and ionizing radiation is another well-established culprit. The more pernicious effects of the thousands of synthetic chemicals in the contemporary environment are being elucidated with current research. Children are inherently more vulnerable to these effects due to their smaller size, higher metabolic rates, developing organ systems and longer lifetime in which to develop cancer.

Figure 3.3. Cancer Rates in NYS



Source:
National Cancer Institute. State Cancer Profiles.
Retrieved Oct 15, 2013 from statecancerprofiles.cancer.gov

As the 2008-9 President's Cancer Panel stated, "the true burden of environmentally induced cancer has been grossly underestimated. With nearly 80,000 chemicals on the market in the United States, many of which are used by millions of Americans in their daily lives and are un- or understudied and largely unregulated, exposure to potential environmental carcinogens is widespread" (47).

Exposures of emerging concern include organic solvents, fuel combustion products, endocrine disrupting chemicals (EDCs), nanoparticles and pesticides (47).

A study published in the American Journal of Public Health in 2001 reported an association between household chemical use and acute lymphoblastic leukemia (ALL). In the study, the researchers from the National Cancer Institute (NCI) and the University of Minnesota found that children were more likely to develop ALL if they lived in households where family hobbies involved the use of solvents (such as refinishing furniture or building models). The study "found elevated risks for childhood ALL associated with substantial postnatal exposure to some household activities and pre-birth and postnatal exposure to indoor house painting," especially if more than 4 rooms in the house had been painted while the mothers were pregnant (48).

The link between pediatric cancer and pesticide use is increasingly clear. According to the Children's Cancer Group Epidemiology Program, a program of collaborative cooperative clinical trial groups supported by the National Cancer Institute, children are 5 to 6 times more likely to develop leukemia and brain cancer if their families use pesticides in the home (49).

Developmental Disorders

Neurodevelopmental disorders, including attention deficit/hyperactivity disorder (ADHD), autism, learning disabilities (including dyslexia and intellectual disability) and cerebral palsy are common, costly and can cause lifelong disability among children in New York. The Centers for Disease Control and Prevention (CDC) reports that developmental disabilities have been increasing, such that approximately 1 in 6 children were affected in 2006-2008 (50). The National Academy of Sciences finds that environmental exposures contribute to at least 28% of neurodevelopmental disorders (51).

ADHD describes a condition in which a child has difficulty paying attention, controlling impulses and/or exhibits disruptive or hyperactive behavior. Obviously, ADHD makes learning and socialization challenging. It has been diagnosed in 4.5 million children 5-17 years of age in the US (52). An additional 4.6 million children are diagnosed with learning disabilities (52). Diagnosis of ADHD increased an average of 3% per year from 1997 to 2006, and an average of 5.5% per year from 2003 to 2007 (53). A 2008 study estimated over 100 million lost parental work days nationally (54). This, along with the cost of educational services and medical treatment brings the economic cost of ADHD conservatively to $42.5 billion annually (55).

Prenatal exposures to lead and to tobacco smoke have been specifically linked to ADHD (56). Prenatal exposures to phthalates have been linked to functional abnormalities similar to those seen in ADHD (57).

NYS Snapshot

More than one in every six children in New York—over 800,000 children total—has a special health care need (a chronic physical, developmental, behavioral or emotional conditions requiring an above routine type or amount of health and related services) (59)

260,000 children (6.8%) of children ages 2 to 17 were identified as currently having ADHD in 2007 (60)

Approximately 2.8 million New Yorkers of all ages have some type of learning disability (10)

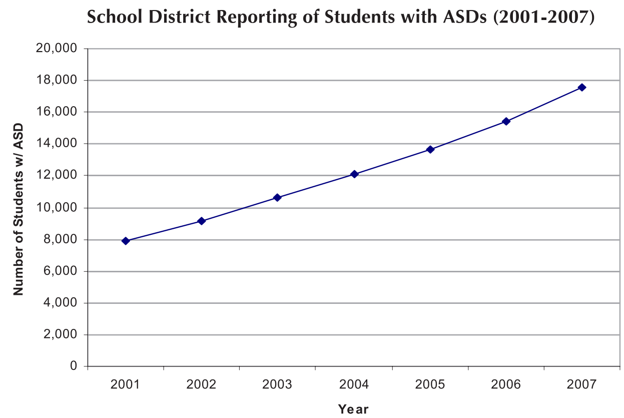
According to the State Department of Education, there were over 150,000 students with specific learning disorders in the New York State public school system as of October 2012 (61)

According to a 2007 report by the New York State Assembly Committee on Mental Health, Mental Retardation and Developmental Disabilities, there has been a seven hundred percent increase in the number of children in New York State diagnosed with autism since 1992 (62). In 2010, this amounted to over 56,000 children with autism (63)

Autism Spectrum Disorders (ASD) are characterized by impaired social interactions, impaired communication, and restrictive/repetitive behaviors. Like ADHD, autism is a chronic condition and can have varying severity. The more severe forms require lifelong specialize educational and care. ASD currently affects 1 of every 88 children born in the United States (58). This reported prevalence is substantially higher than that of a decade earlier. Similar increases have been noted in the UK, Europe and Japan.

The causation of autism has been the focus of intense investigation. Elegant research has identified a series of genetic factors—mutations, deletions and copy number variants—that are clearly implicated. But none of these genetic factors accounts for more than a small fraction of cases, and genetics does not easily explain key clinical and epidemiological features of autism. It therefore seems probable that environmental exposures in early life may also contribute to some cases of autism, perhaps acting in synergy with individual genetically determined susceptibility factors. There is no credible epidemiologic evidence that childhood vaccines or any of their components cause autism.

Figure 3.4. Autism in NYS



Source:
New York State Interagency Taskforce on Autism (2010). Albany, NY: New York State Office of Mental Retardation and Developmental Disabilities

A major intellectual insight that has substantially advanced understanding that the environment is a powerful cause of neurodevelopmental disorders is recognition that exposures in the environment can exert a range of adverse effects. Some of these effects are clinically evident and are diagnosed as disorders such as ADHD, learning disabilities or autism. But others can be discerned only through special testing and are not evident on the standard examination. This recognition gave rise to the term **subclinical toxicity**. The underlying concept is that there exists a dose-dependent continuum of toxicity, in which clinically obvious effects have their subclinical counterparts. The concept of subclinical toxicity traces its origins to epidemiological studies of lead toxicity in clinically asymptomatic children. These studies showed that low-dose exposures to lead could cause decreases in intelligence and alterations in neurobehavioral function even in the absence of clinically visible symptoms (64). The subclinical toxicity of lead has subsequently been confirmed in prospective epidemiological studies. Subclinical neurotoxicity has more recently been documented in children exposed to other toxic chemicals such as methylmercury (65) and PCBs (66). Exposures to these chemicals during early development can cause brain injury at dose levels much lower than those that affect adult brain function.

Psychiatric Disorders

include anxiety, depression and schizophrenia: these are chronic, lifelong conditions that generally are considered to be adult problems. But recent research has shown that half of all cases of mental illness begin by age 14 (67). And changes to the brain that predispose to these conditions begin still earlier.

Many psychiatric disorders in young people co-occur with other mental or physical illnesses, and diagnoses can be complicated. Anxiety disorders include panic disorder, obsessive-compulsive disorder, post-traumatic stress disorder, generalized anxiety disorder, and phobias. These disorders frequently co-occur with other psychiatric disorders, including depression

and substance abuse (67).
Mental disorders are the leading cause of disability in the U.S. and Canada for ages 15-44 (68). For the same age group in the U.S., major depressive disorder is the leading cause of disability (68). Epidemiological studies indicate that up to 2.5 percent of children and up to 8.3 percent of adolescents in the U.S. suffer from depression (69), and research indicates that depression onset is occurring earlier in life today than in past decades (70).

Approximately 2.2 million American adults, or about 1.1 percent of the population age 18 and older in a given year, have schizophrenia (71). Schizophrenia now ranks among the top 10 causes of disability in developed countries worldwide (72).

NYS Snapshot

Approximately 500,000 children in New York State have a serious mental illness (79)

In New York State, suicide is the third leading cause of death in children 10-10 years old. The average number of hospitalizations resulting from self-inflicted injuries rose among youth ages 15 to 19 years, from 1,147 in 1999-2001 to 1,331 in 2008-2010. Youths outside NYC are almost 50% more likely to be hospitalized (80)

The New York State public mental health system provides services to approximately 541,884 people each year. 120,694 of these are children between the ages of 0-17 (81)

In September of 2006, the Children's Mental Health Act (CMHA) was signed into law, declaring that untreated mental health problems in children have serious consequences. The legislation noted that emotional and behavioral problems affect a child's ability to learn and increases their propensity for violence, alcohol and substance abuse and other delinquent behaviors that are extremely costly to treat. It cited a finding that 1 in 10 children in New York suffers from a mental illness severe enough to cause some level of impairment, and pointed out that in any given year only 20 percent of these children receive mental health services (82)

A recent survey by the US National Center for Health Statistics indicates that the number of children diagnosed with bipolar disorder rose from 20,000 in 1994 to approximately 800,000 in 2003, representing a 40-fold increase and making bipolar more common than depression among children (73).

Recent scientific research has examined the causal relationship between prenatal exposure to neurotoxicants and psychiatric disorders. While the existing body of evidence is at present somewhat limited, emerging data suggest a potential link and highlights the need for more extensive examination of this relationship through scientific study. Existing research has primarily looked at the effects of animal exposures and adult exposures in occupational settings. A compilation of the existing data has indicated a correlation between anxiety disorder and depression and exposure to mercury, organophosphates (pesticides), lead, and organic solvents (10).

While family studies indicate that genetic vulnerability is a risk factor for schizophrenia (74), among individuals with schizophrenia who have an identical twin, and thus share the exact genetic makeup, there is only a 50 percent chance that both twins will be affected with the disease. These studies suggest that factors such as environmental stress (occurring during fetal development or at birth) may also contribute to the risk of schizophrenia (75, 76). Research has suggested that schizophrenia may be a developmental disorder resulting from impaired migration of neurons in the brain during fetal development (77), and some people with schizophrenia have anatomical abnormalities in brain structure such as enlarged ventricles

(78). A current version of the "neurodevelopmental hypothesis" of schizophrenia states that gene-environment interactions alter the structure and function of the developing brain, contributing to the onset of schizophrenia later in life (83). While this hypothesis is now widely accepted, the mechanisms underlying putative developmental antecedents are the subject of an ongoing debate.

A significant body of research has identified prenatal lead exposure as one potential environmental insult that could play a role in the development of schizophrenia. A prospective cohort study based in Cincinnati associated prenatal lead exposure greater than 10 µg/dL with an increase of 2.3 more delinquent acts as compared to exposures less than or equal to 5 µg/dL. Significantly higher rates of delinquent behavior are related via a categorical blood lead measured prenatally and at 78 months old, although not by average childhood blood lead (84). In the US and around the world, early childhood exposure to lead appears to be tightly correlated with delinquent behavior in adulthood (85). The delinquent behavior and behavior and social difficulties, deficits, described in adolescence following early life exposure, are comparable to the early antecedents of schizophrenia and other spectrum disorders.

Obesity

Obesity is a problem of epidemic proportion for children, both in New York and across the United States. According to National Center for Health Statistics (NCHS), more than 1 on 6 of the nation's children ages 2-19 are overweight (86). This represents a dramatic jump in prevalence since the first sets of data were collected in the 1960's. The increase from 5.1% in 1971-1974 to 16.9% in 2009-2010 is 330%. Obesity among children ages 6-11 increased 450% in the same period. Currently 1 in 5 boys ages 6-11 is obese.

Overweight and obesity are measured by body mass index (BMI)—which is a measure of weight in relation to height. For children and adolescents age 2-19, overweight is defined as a BMI at or above the 85th percentile and lower than the 95th percentile for children of the same age and sex, while obesity is defined as a BMI at or above the 95th percentile.

Obese children are at elevated risk for numerous health problems, including cardiovascular disease, asthma, joint disease and Type-2 diabetes. There are also associated psychosocial risks that can hinder self-esteem and have long-term developmental consequences. Obese children are far more likely to become obese adults. One study found that approximately 80% of children who were

NYS Snapshot

Obesity among New York's children and adolescents has tripled over the last three decades (86)

Recent data indicate that 33.8% of all public school students in New York State (excluding NYC) are overweight or obese (NYSDOH). 40% of NYC school children are overweight or obese (89)

Among children ages 10-17 across the state, 46.9% of blacks and 35.8% of whites are overweight or obese compared to 26.7% of whites; 44.1% of children below the federal poverty level are overweight or obese (96) overweight at age 10-15 were obese adults at 25 years of age (87).

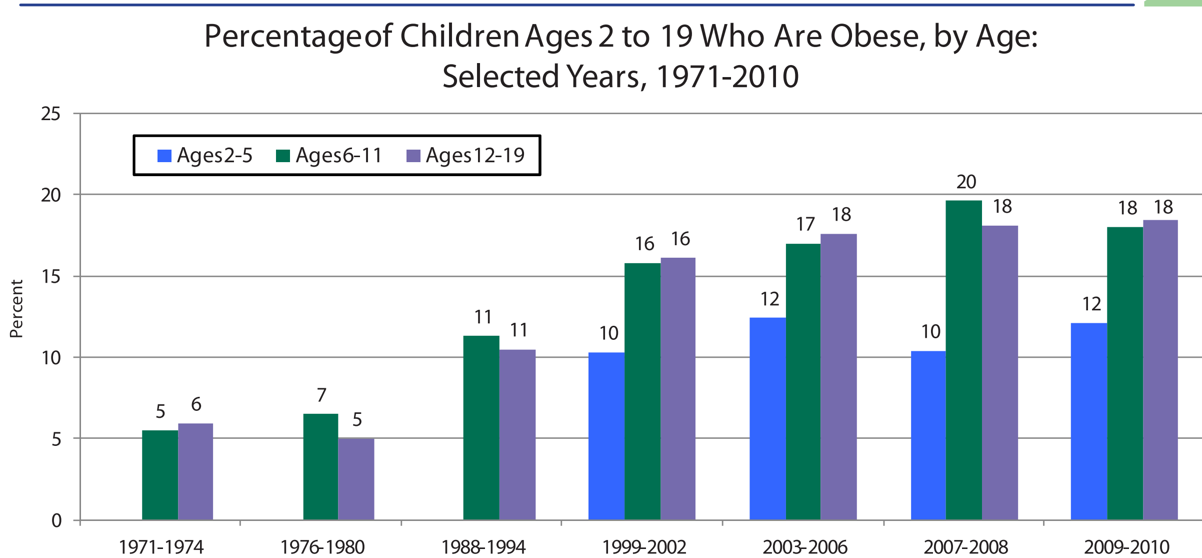
The implications of this rising epidemic of obesity are staggering not only for their impending disease burden, but also threatens to have severe impacts on the State's quality of life and health care costs. The likelihood that an obese child will become an obese adult increases with age and the severity of obesity (88). As this generation of children reaches adulthood, there will be a dramatic increase in physical complications associated with diabetes (e.g., amputations, blindness, kidney failure, heart attacks).

As the The New York City Obesity Task Force Planto Prevent and Control Obesity 2012 report states, "obesity is an environmental disease" (89). More explicitly, obesity is caused by complex interactions between genetic, environmental and behavioral factors. While our physiology has not changed over the generations, we've changed the conditions under which we live, and our behaviors follow suit. Contributors include: eating behavior (excess calories), sedentary lifestyle, and the built environment (e.g., sidewalks and transportation systems).

The urban built environment has been implicated as a major cause of childhood obesity. Contributing factors in the urban built environment include lack of safe play spaces for children, lack of walkways and sidewalks, reduction in school physical education programs, absence of healthy foods, overabundance of "junk foods" and sodas, sedentary life style and too much time spent in front of televisions and computers.

Schools and child care facilities can contribute either positively or negatively to risk of childhood obesity, depending on whether they serve healthy meals, permit vending machines with unhealthy drinks and snacks, or require physical activity. For some low income or homeless

Figure 3.5. Obesity in NYS



Source:
Child Trends Databank. (2013). Overweight Children and Youth

children, school meals (breakfast, lunch, after school snacks) may be their best and most reliable source of daily caloric intake.

Certain toxic chemicals may also contribute to obesity. Data from several epidemiologic studies suggest that exposure to dioxin (2,3,7,8-tetrachlorodibenzo-p-dioxin) increases the risk of diabetes mellitus (90, 91). Chemicals with the ability to disrupt endocrine function (EDCs) may also interact with genetic and environmental factors to influence somatic growth, puberty and obesity (92-95). One potential endocrine-disrupting chemical, Bisphenol A (BPA), is used to manufacture polycarbonate resin, and is detected in the coatings of food and beverage containers.

Injuries

Unintentional injuries, which include drowning, falls, burns, transportation-related injuries, poisoning and suffocation are the leading cause of death in American children each year. Every day in the United States, approximately 20 children die from a preventable injury (97). In the period between 2000 and 2006, unintentional injuries took the lives of an average of 12,175 children aged 0 to 19 each year (97).

NYS Snapshot

During 2000 to 2006, the death rate caused by unintentional injuries for all age groups increased 10 percent in New York State (100)

In New York, there were 2,503 unintentional injury deaths for all ages in 2000-5 (99). In 2006-8 there were over 1000 deaths for just children (101).

In 2006-8 there were 460,000 emergency visits among children ages 0-19 (101)

Overall, transportation related injuries kill more children than any other type of injury. But age groups differ. Infants less than a year old are most likely to die of suffocation; 1 to 4 year old children are most at risk of drowning death; whereas children 5 to 19 are most often killed when involved in motor vehicle crashes (97).

Many injuries are non-fatal, but nonetheless serious and costly. Among the major non-fatal injuries are falls, being struck by or against an object, insect bites or stings, motor vehicle accidents, and overexertion (97). Approximately 5 million people in the United States currently suffer from chronic, lifelong disabilities due to injury (98).

Injuries have wide-ranging causes, many of which are environmental. The role of the environment in injury is most strongly proven for physical barriers and structures that predispose children to injury. Past studies on the causes of childhood injury have given communities the data and resources to pass laws and develop proactive interventions such as free smoke detectors and child safety caps on medicine bottles. Traffic, backyard swimming pools, staircases, weapons, fire, and household poisons pose the greatest threats to a child's safety, yet are common presences in many children's lives.

The chemical environment may also play a role in causation of childhood injury. Neurotoxicants such as lead, mercury, and polychlorinated biphenyls have been associated with increased aggression, delinquency, hyperactivity, impulsivity, and poor socialization skills—all which predispose children to injury because affected children fail to recognize hazards or because their antisocial behaviors are more likely to place them or others in harm's way.

As the intricate relationships between environmental hazards and human health are elucidated, it's important to provide matching, appropriate health care methods and treatments. As medicine looks upstream to address the fundamental causes of disease and disability, we are confronted with the plight of children and pregnant women who are subject to the environmental forces and factors largely outside of their control. As the World Health Organization states in its 2006 report, "approximately one-quarter of the global disease burden, and more than one-third of the burden among children, is due to modifiable environmental factors" (102). Equally, as we work toward safer environmental policies, we must provide care for all who are currently suffering. This requires trained health care providers, working at the patient-level and at the community level to address the needs of the people.

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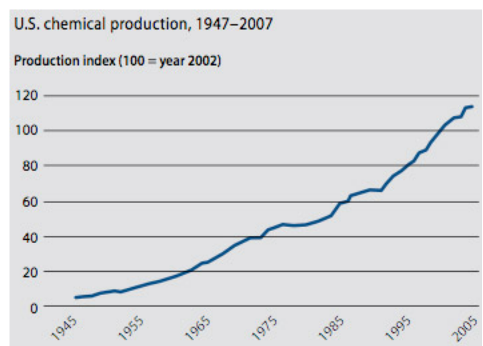
Environmental Hazards Confronting New York's Children

Children's environments have changed profoundly in the past fifty years. A critically important component of this change has been the synthesis, manufacture and wide dissemination into the environment of tens of thousands of new synthetic chemicals.

Today more than 80,000 synthetic chemicals are registered with EPA for potential commercial use. Nearly all of them are new chemicals, invented within the past fifty years. New York's children are at especially high risk of exposure to the 3,000 synthetic chemicals that are produced in quantities of more than one million pounds per year (1). These high-production-volume synthetic chemicals are used in millions of consumer products ranging from food packaging to clothing, building materials, motor fuels, cleaning products, cosmetics, medicinal products, toys and baby bottles. They are widely distributed in children's environments—in air, food, water, and consumer products. They can enter children's bodies by ingestion, inhalation or transdermal absorption.

National surveys conducted by the Centers for Disease Control and Prevention find measurable quantities of more than 100 high-production-volume synthetic chemicals in bodies of virtually all Americans (2). High-production-volume synthetic chemicals are detected today in the breast milk of nursing mothers and in the umbilical cord blood of newborn infants (3). Children's exposures to synthetic chemicals have become the focus of great concern in pediatric medicine.

Figure 4.1. US Chemical Production



Source: UCSF Program on Reprductive Health and the Environment. (2008). Shaping Our Legacy: Reproductive Health and the Environment.

Some new synthetic chemicals have profoundly benefitted the health of New York's children. Antibiotics have helped control the major communicable diseases. Chemical disinfectants have brought safe drinking water to millions and reduced deaths from dysentery. New chemotherapies have made possible the cure of many childhood cancers.

But new chemicals have also been responsible for tragic episodes of disease, death and environmental degradation. Many of these episodes have resulted in severe injury to children.

In far too many of these tragic episodes new chemicals were brought to market with great enthusiasm, came into wide use and were widely disseminated in the environment. Then belatedly they were found to have harmful effects to children's health and the environment. A recurrent theme has been that commercial introduction preceded any systematic effort to assess potential toxicity. Especially absent were any advance efforts to examine possible impacts on children's health or potential to disrupt early development.

Examples of inadequately tested new chemicals that resulted in tragedy include the thalidomide disaster in which over 10,000 babies worldwide were born with congenital defects of the limbs as the result of exposure during early pregnancy to an untested drug taken by their mothers to reduce morning sickness; the addition of lead to paint and gasoline; the use of asbestos as insulation; DDT; polychlorinated biphenyls (PCBs); the di-ethyl stilbestrol (DES) tragedy in which girls and young women developed cancers of the reproductive organs after exposure in the womb to a synthetic estrogen; and the ozone-destroying chlorofluorocarbons (CFCs) whose harmful effects on the environment were mitigated by early recognition and global ceassation of manufacture.

A second theme in many of these episodes is that early warnings of danger were ignored. As a result, efforts to control exposures and to prevent injury were delayed, sometimes for decades.

A major problem today is that a high proportion of the most widely used synthetic chemicals have never been tested for their possible toxicity. There has been systematic failure to conduct premarket evaluations of synthetic chemicals before their introduction to commerce. This reflects the weakness of the federal Toxic substances Control Act and represents a grave lapse of stewardship. In consequence of the failure to test chemicals for safety:

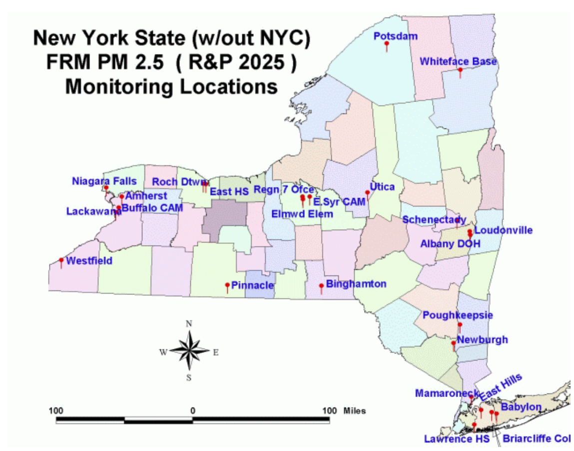
> Information on potential to cause injury to human health is not available for about half of the 3,000 HPV chemicals.
>
> Information on potential to cause injury to the development of infants and children is not available for about 80% of HPV chemicals.

Air Pollution

Outdoor air pollution is a complex mix of particulate matter and gases, including ozone, oxides of nitrogen and carbon monoxide. Particulate and gaseous components of air pollution commonly coexist. Both are linked to adverse effects on human health (3-5).

Airborne particulates vary in size and chemical composition depending on their source of origin. Combustion of fossil fuels is the most important source of airborne particulates in modern urban environments, apart from second-hand cigarette smoke. Particle size is a major determinant of the health impacts of airborne particulates. Larger particles with mass median airborne diameter of 10 microns and above (PM10) are usually filtered out of inhaled air in the upper airways and do not penetrate deeply into the lungs. Fine particles (<2.5 µm in diameter) are capable of penetrating deep into the tracheobronchial tree.

Figure 4.2. NYS $PM_{2.5}$ Monitoring Sites



Adapted from
http://www.dec.state.ny.us/website/dar/baqs/upstateloc.gif

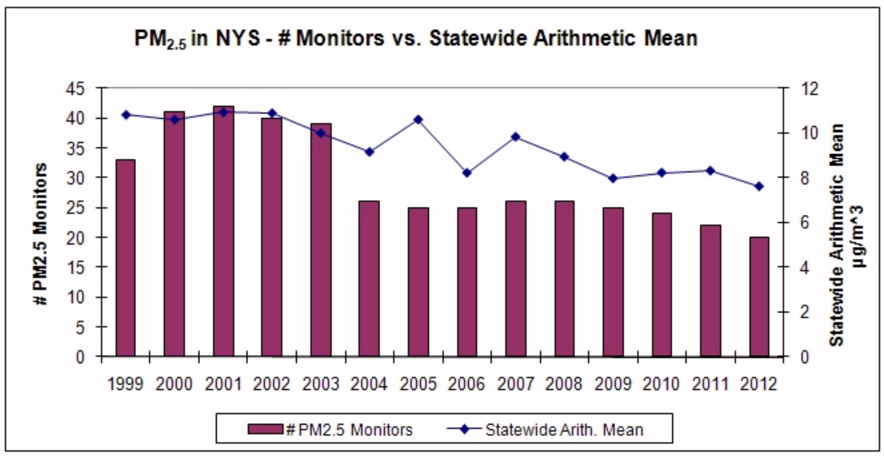
Children are very sensitive to air pollution because they are more active than adults and therefore inhale a proportionately greater volume of air. Children are sensitive also because their airways have narrow diameters and their lungs and tracheobronchial tree are still growing and maturing. In addition, the defenses that help adults resist infections are still developing in children. Children also have more respiratory infections than adults, which further increases their susceptibility to air pollution.

There are extensive data on outdoor air pollution in New York State. The Division of Air Sources' Bureau of Air Quality Surveillance of the Department of Environmental Conservation is responsible for the operation of the Ambient Air Quality Monitoring Network for the State.

This continuous monitoring network collects ozone, SO2, nitrous oxides, CO, and meteorological data. The program also operates the manual monitoring network. The manual monitoring system monitors for PM2.5, PM10, lead, acid rain, metals, and toxic organic compounds. Data from the Network are placed on its Website hourly, every day, from 5 AM to midnight with live data from a series of continuous monitoring sites (6). Figure 4.2 above provides a map of existing New York State monitoring sites for PM2.5.

The New York State air monitoring network documents that average air quality in New York State has improved over the past fifteen years (See Figure 4.3). However, there is much region-specific variability in air quality across the State.

Figure 4.3. NYS $PM_{2.5}$ Average over Time



Adapted from
http://www.dec.ny.gov/chemical/54359.html

Health Effects of Outdoor Air Pollution

Short term exposure to particulate pollution is associated with acute asthmatic attacks, wheezing, coughing, respiratory irritation, increased emergency room visits, hospitalizations and increased mortality from respiratory disease (7). In adults, air pollution triggers heart attacks, cardiac arrhythmias and premature death (8).

In 2004, the World Health Organization (WHO) published a comprehensive report on children's health and air pollution. This report concluded that air pollution caused the following harmful effects in children:

Short-term and long-term decreased lung function rates

Aggravation of asthma (from exposure to particle as well as ozone pollution)

Increased prevalence and incidence of cough and bronchitis (primarily from particle pollution)

Increased risk of sudden infant death syndrome (SIDS) (7)

Increased risk of upper and lower respiratory infections (9)

Prenatal exposure to air pollution can cause fetal injury. A study of pregnant women in four Pennsylvania counties with high levels of air pollution found an increased risk of preterm births (x). A study in the Czech Republic found evidence that a mother's exposure to air pollution may alter the immune system of her fetus (x). A study of three low-income neighborhoods in New York City with high levels of air pollution found that infants faced a possible increased risk of cancer (x). Ambient air pollution is associated with increased risk of sudden infant death syndrome (SIDS) (10).

Diesel Exhaust

Diesel exhaust from trucks and buses is a major source of particulate air pollution in New York State. Diesel exhaust is very important for child health.

Evidence is overwhelming that exposure to diesel exhaust causes cancer and premature death and that it also exacerbates asthma and other respiratory illnesses. Based on lifetime risks, that diesel exhaust is estimated to be responsible for 125,000 cancer cases nationwide per year (11). Based on information available from the EPA's National-Scale Assessment of Air Toxics, the cancer risks from diesel emissions are about ten times higher than the cancer risks from all other hazardous air pollutants combined. For the U.S. as a whole, the average cancer risk associated with diesel emissions represents 80% of the total estimated cancer risk from all hazardous air pollutants (12). In 2013, the International Agency for Research on Cancer, the cancer agency of the World Health Organization, declared diesel exhaust to be a proven human carcinogen.

The Natural Resources Defense Council estimates that for every million children riding a school bus for 1 or 2 hours each day during the school year, 23 to 46 children may eventually develop cancer at some point in their lives caused by the excess diesel exhaust that they inhale. This means a child riding a school bus is being exposed to as much as 46 times the cancer risk considered "significant" by EPA under federal law (13).

Indoor Air Pollution

Because average American kids spend more than 90 percent of their time indoors, indoor air pollution can also influence health.

Sources of Indoor Air Pollution

There are numerous sources of indoor air pollution. These include second-hand cigarette smoke; cooking; burning fuels; pesticide use; building materials and furnishings (older materials can deteriorate and release hazards such as asbestos or PCBs, while newer materials, such as PVC flooring, pressed-wood products and carpets, cleaning products, paints and finishes can off-gas toxic chemicals. Pollutants can also enter homes from the outside (examples include radon, , and transportation related air pollutants); or can result from the activities of occupants (smoking, hobbies, take home occupational). Vapor intrusion into a home can lead to formation of mold. Location of a child's apartment above a dry cleaning shop can result in entry of dry cleaning solvemnt fumes into the apartment. Demolition and construction can release pollutants into the air.

Concentrations of pollutants in indoor air can be 5-100 times greater than those found outdoors and can cause considerable damage to children and workers in homes, buildings and schools (5). Source reduction of pollutants indoors and maximizing ventilation with clean air are important determinants of levels of indoor air pollution. If a building is too air-tight, indoor pollutants can accumulate to high levels.

Health Effects of Indoor Air Pollution
Indoor pollutants can cause a wide range of problems from asthma to flu-like symptoms such as headaches, sore throats, memory problems, joint pain, and nausea. Children and adults with pre-existing health problems including asthma, allergies, or chemical sensitivities generally are more susceptible to poor indoor air quality (5). Poor indoor air quality can adversely affect children's ability to learn.

NYS Snapshot

According to the American Lung Association's 2013 State of the Air Report Card, NYS leads the nation in deaths and disease caused by diesel exhaust.

NYS law protects air quality in schools. The Public Employees Safety and Health Act (PESH) protects teachers, administrators, and staff at public schools from toxicants in air. Consequently, children at school are protected against poor indoor air quality.

NYS regulation specifically requires that each teaching space should have a constant supply of fresh air to avoid problems of odor, toxins and dust build up. In addition, the New York City Health Code, section 45.11 requires that each school room be properly ventilated, but not so well-ventilated as to cause drafts.

Regulations of the Commissioner of Education, known as the RESCUE (REbuild SChools to Uphold Education) regulations, require schools to have an indoor air quality management plan; generally require schools to have a controlled supply of fresh air and have sufficient air changes to produce healthful conditions and avoid odors or build-up or concentrations of toxic substances or dust particles and provide for specific protections to protect air quality during school construction and renovation projects.

The NYC Administrative Code specifically states that buses cannot leave their motors running for more than three minutes, and cannot leave them running at all when it is warmer than 40 degrees outside. In 2009, the idling limit was reduced to one minute in areas adjacent to schools.

NYS Environmental Conservation Law limits idling time of trucks and busses, including school busses, to five minutes. Fines for the first violation range from $375 to $15,000 (14)

In June, 2009, the New York State Environmental Board approved the implementation of the New York State Diesel Emission Reduction Act of 2006 (DERA), which dictates retrofitting of old, dirty diesel engines with new Ultra Low Sulfur Diesel (ULSD) technologies (15)

In 2011, New York City ordered phase-out of the most polluting grades of diesel fuel (#6 and #4) in New York City stationary boilers. Only 1 percent of buildings in the city burn the dirty oil, but are responsible for more than 85 percent of all the soot pollution from buildings

Lead

Lead is a heavy metal that has been mined, smelted, and used for millennia in products such as paint, gasoline, pipes, crystal and ceramics. Lead is widely disseminated in the modern environment (5).

Sources of Lead
Lead-based paint in older housing is the most important source of lead exposure for children in New York State today. Oral ingestion of lead paint chips or – much more commonly, the dust that forms when lead-based paint flakes and erodes - is the most common route of children's exposure to lead. Other sources of lead exposure include contaminated soil, food and drinking water. Lead can also be found in products used in and around our homes, schools and communities, including many common products used by children such as jewelry, lunchboxes and toys. 5

Recent studies indicate that residential dust lead level is a strong predictor of childhood blood lead levels (16). Older residences with deteriorated lead-based paint are most likely to have higher levels of lead in house dust and in surrounding soil. According to the 2000 National Survey of Lead and Allergens in Housing, twenty-four million housing units nationwide still today have significant lead-based paint hazards that could place children at risk for lead poisoning (17).

Lead has been found in child care centers and in schools in paint and drinking water, as well as on playgrounds near highways and bridges, or leaching from synthetic turf. Another source often overlooked is vocational education activities (automotive shop, welding) and indoor and shooting ranges at school where lead dust accumulates.

Health Effects of Lead

Damage to the brain and nervous system is the most serious consequence of children's exposure to lead. The developing nervous system of the fetus, infant and young child is highly susceptible to lead (5). Lead can cross the placenta from a mother to her child during pregnancy and then enter the fetal brain and interfere with brain development. The consequences are loss of intelligence, shortening of attention span and disruption of behavior. Because the brain has little capacity for repair, these effects are permanent, untreatable and irreversible. They last lifelong. The most recent research indicates that lead can damage the infant brain to cause brain injury at blood levels of 5 µg/dL and even lower There appears to be no threshold level of lead in blood below which lead does not cause damage to the developing human brain.

The long-term consequences of lead exposure in early life are learning disabilities, increased school drop-out rates, increased risk of criminal behavior and increased incarceration. Lead has been linked to ADHD. All of these effects diminish children's ability to fulfill their potential and place great economic burdens upon families and society.

Controlling lead hazards can produce significant cost savings for the state. A 2009 cost-benefit

NYS Snapshot

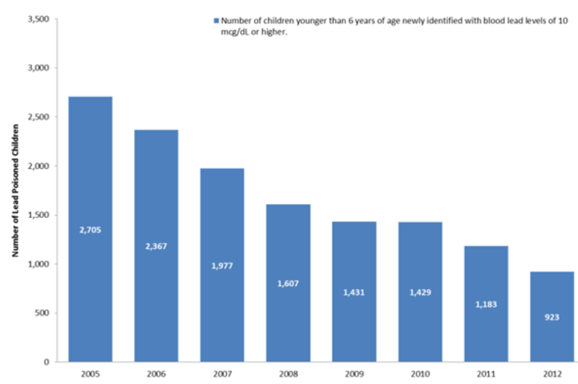
NYS has a major lead paint problem, because it has one of the nation's oldest housing stocks and the largest number of housing units built prior to 1950 (5).

An estimated 430,000 housing units in New York State have high risk of lead hazards (19).

Kings County (Brooklyn) alone accounts for approximately one fourth of all housing units statewide with lead risks, but Westchester, Erie and Onondaga Counties all have a significant number of homes with lead paint hazards.ix (See Table 4.1).

In New York City , significant progress has been made in reducing the incidence and severity of lead poisoning cases. (See Figure 4.4.) In 2012 there were 923 children under 6 years of age identified with lead poisoning, a 22% decline compared to 2011, when the total was 1,183. The number of childhood lead poisoning cases has declined 66% since 2005 when NYC implemented Local Law 1, the Childhood Lead Poisoning Prevention Act.

Figure 4.4. NYS Children with Pb Poisoning



Adapted from
NYC DOH&MH. Childhood Blood Lead Registry 2005-2012.

New York State has established statewide efforts to address lead poisoning including the lead poisoning prevention programs and lead poisoning primary prevention in target high risk areas. There are also HUD funded programs for lead abatement.

Certain populations remain at increased risk for lead poisoning. These include children under 3 years of age, low income children in older, deteriorating housing, children of color, and children born outside the U.S.5

analysis conducted by the Economic Policy Institute found that for every dollar spent on controlling lead hazards, between $17 and $221 would be returned in health benefits, increased IQ, higher lifetime earnings, tax revenue, reduced spending on special education, and reduced criminal activity (18).

Table 4.1. New York State Counties with Highest Numbers of Housing Units with Lead Hazards.

County	Number of housing units
Kings	130,000
New York	68,000
Bronx	59,000
Queens	56,000
Erie	20,000
Westchester	12,000
Monroe	11,000
Nassau	9,000
Onondaga	7,700
Oneida	5,300

Adapted from http://www.scorecard.org/env-releases/lead/state.tcl?fips_state_code=36

Mercury

Mercury is a naturally occurring metallic element. Mercury is liquid at room temperature and easily vaporizes into air. Mercury is released to the environment through mining, coal combustion and through its use in manufactured products. Human activity is responsible for 70 percent of the mercury released to the global environment each year (20). Mercury is found in some dental fillings, vaccines, fluorescent lights, batteries, and thermometers (21).

Coal-burning power plants are the largest single source of mercury emission in North America. They are responsible for more than 40 percent of all airborne mercury emissions in the U.S. Metallic mercury emitted to the air from coal-burning power plants and other sources returns to earth via precipitation, enters rivers, lakes and the oceans, and accumulates in marine sediments. Marine microorganisms convert this mercury into highly toxic methylmercury. Methylmercury is persistent in the environment and is bioaccumulative. It concentrates to high levels in predatory fish at the top of the food chain (5).

Sources of Mercury

Consumption of contaminated fish is the most common route of human exposure to methylmercury. In 2012, the New York State Department of Health issued fish consumption advisories for 150 bodies of water across the State that have mercury contaminant levels for certain fish species higher than federal standards. The New York State Department of Health has indicated that women of childbearing age and children under the age of 15 should not eat any fish from these bodies of water.

Exposure to forms of mercury other than methyl mercury can occur through absorption of metallic mercury from dental fillings and from vaccinations containing the ethyl mercury preservative thimerosal, but these are much less toxic to the developing brain than methylmercury. Currently, all routinely recommended vaccines for U.S. infants are available only as thimerosal-free formulations or contain only trace amounts of thimerosal (≤1 than micrograms mercury per dose), with the exception of the inactivated influenza vaccine (21).

Children can be exposed to metallic mercury in their schools. Inhalation of mercury vapor is the principal route of exposure at school. Instruments containing mercury can be found widely on school property—in the nurse's office, science rooms, gymnasiums, art rooms and boiler rooms. Liquid mercury is used in instruments that measure temperature (thermometers), pressure (barometers or sphygmomanometers), humidity (hygrometers), vacuum (laboratory manometers), flow (water meters) and air speed (anemometers). Mercury can also be found in lights (particularly gymnasium and fluorescent lights), thermostats, heating/ventilation and air conditioning (HVAC) systems, plumbing systems, cafeteria equipment, medical devices, regulators, gauges, and science room equipment. The States of Ohio and Michigan found mercury in gym flooring. At times, children or adults who are unaware of the health hazards bring mercury into schools to play with, for demonstrations or to use in cultural rituals (5). In 2006, a case was reported in Franklinville, NJ in which a day care center was sited in a former mercury thermometer factory. Residual mercury contamination in the structure of the building led to elevated blood mercury levels in numerous children attending the day care center (22). The Agency for Toxic Substances and Disease Registry (ATSDR) has produced a guidance document describing how to clean up metallic mercury spills in schools (23).

Health Effects of Mercury

Methylmercury is a potent neurotoxicant. While adverse effects of mercury exposure have been reported in adults, the effects of methylmercury toxicity on children and on the developing brain are of particular concern. Infants exposed in the womb when their pregnant mothers eat mercury-contaminated fish are especially at risk.

The toxicity of methylmercury to the de-

NYS Snapshot

It is estimated that each year in New York between 25,000 and 50,000 children suffer subclinical loss of intelligence and that 125 develop mental retardation as a consequence of prenatal exposure in pregnancy to methyl mercury.

NYS Department of Environmental Conservation Law requires schools to identify and remove elemental mercury from school facilities.

Legislation signed into law in 2005, NY State Law, Chapter 603, prohibits the administration of vaccines having certain mercury levels to persons under the age of three years and to pregnant women.

Legislation signed into law in 2005, NY State Law, Chapter 676, prohibits the sale and distribution of certain mercury added products; requires manufactures and trade associations dealing in mercury-added products to report certain information to the state Department of Environmental Conservation.

NY State Law, Chapter 611 of 2006 provides for the phase out of mercury added components in motor vehicles within five years.

NY State Department of Environmental Conservation's Final Regulations on the Management of Mercury and Dental Amalgam Wastes at Dental Facilities, effective May 12, 2006: Section 27-0926, in the Environmental Conservation law, "Use and recycling of elemental mercury and dental amalgam by dentists" prohibits the use of non-encapsulated elemental mercury in dental offices and requires dentists to recycle any elemental mercury or dental amalgam waste generated in their offices in accordance with regulations that the Department promulgates.

The NYS Department of Environmental Conservation has established a Mercury Task Force to coordinate its response to issues on mercury and the environment, including providing recommendations to the commissioner and addressing issues concerning regulating air emissions, remediating and preventing hazardous spills, assisting businesses in finding mercury-free alternatives and monitoring water and habitat to keep toxic levels safe for fish, wildlife and humans.

The New York State Health Department recommends that containers of elemental mercury identified by staff or found during an inventory be given the highest priority for removal. Should a spill occur, many individuals could be exposed, resulting in negative health effects, significant cleanup costs and widespread environmental contamination.

Brochures are available on the Health Department website about mercury exposure in schools geared toward parents, students, science teachers, buildings and grounds personnel, health and safety committees, superintendents, school boards, principals and school nurses as well as action steps to take if a spill occurs and phone numbers to contact in the case of an emergency (5).

veloping brain was first demonstrated in the 1950s in Minamata, Japan, where consumption of fish with high levels of methylmercury by pregnant women resulted in at least thirty cases of infantile cerebral palsy (24). The infants were born blind, spastic, microcephalic and severely retarded. The mothers showed minimal effects (26). The mercury had been discharged into Minamata Bay by a chemical manufacturing plant. Twenty-two years later, a similar episode in Iraq resulted in infants and children bearing the brunt of exposure when thousands of people were poisoned as a result of eating wheat that had been treated with methylmercury to resist disease and pestilence (25). A more recent study conducted in the Faroe Islands, a territory of Denmark, found reduced IQ scores among children who were born to women with maternal hair mercury concentrations above 6ug/g (26). Women in the Faroe Islands eat a high fish diet that can include whale meat. A second study done in the Faroe Islands highlighted the neurotoxic effects of methylmercury exposure even at low levels. It "found that both prenatal and postnatal mercury exposure affects the brain functions and that they seem to affect different targets in the brain. Children in the study had average exposure levels that were similar to current limits set by the EPA and 95% of them were below the current limit used by the Food and Drug Administration."

In 2004, the Environmental Protection Agency concluded that up to 630,000 of the 4 million babies born annually in the United States could have mercury blood levels at or above the agency's safety limit, almost double its previous estimate. And, according to CDC's National Health and Nutrition Examination Survey (NHANES), for the years 1999-2002, approximately 6 percent of women of childbearing age had blood mercury concentrations at or above 5.8 μg/L, the level assumed to be without appreciable harm (27).

It is estimated that each year in the United States between 300,000 and 600,000 children suffer brain injury with subclinical loss of intelligence as a result of prenatal mercury toxicity. Another 1,500 of these infants develop frank mental retardation in consequence of prenatal mercury toxicity (20).

Pesticides

Synthetic pesticides are a diverse group of chemical compounds used to control insects, unwanted plants, fungi, rodents and other pests. Approximately 900 pesticide active ingredients, including insecticides, herbicides, rodenticides and fungicides, are currently registered for use in the US. These compounds are mixed with each other and also blended with "inert" ingredients to produce more than 20,000 commercial pesticide formulations. The U.S. Environmental Protection Agency (EPA) estimates that each year approximately 1 billion pounds of pesticides are applied in the United States.

Children are at particular risk of exposure to pesticides. National surveys conducted by CDC show that children carry higher body burdens than adults of certain pesticides such as chlorpyrifos. Also children's tissues and organs are rapidly developing, and at various stages in early development these growth processes create windows of great vulnerability to pesticides. An analysis undertaken by the National Academy of Sciences has established that infants and children are the uniquely vulnerable to pesticides.

Sources of Pesticides

Children can be exposed to pesticides via multiple routes, among them consumption of contaminated water, ingestion of pesticide residues in food, inhalation of airborne drift, exposure to pesticides applied in the home, school or community, or from exposure to improperly disposed hazardous waste. Heaviest use of pesticides in the home has been found to occur in inner city neighborhoods for the control of roaches in apartments.

Children come into contact with pesticides daily. Pesticides are applied to lawns, parks and golf courses to control weeds, manage grass and control or eliminate insects, such as mosquitoes. In New York State, children's exposure to pesticides has been reduced subsequent to passage of Chapter 85 of the Laws of 2010 which has practically eliminated the use of pesticides on school athletic fields and playgrounds and day care centers. According to the American Association of Poison Centers, over 146,000 calls are made each year to poison centers with concerns about exposure to common household pesticides, and about half of these calls involve exposures to children younger than 6 years (27). Pesticides, such as roach sprays, rat poison, insect and wasp sprays, repellent and baits, flea and tick shampoos are often in easy reach, as are weed killers and other lawn and garden pesticides.

A survey conducted by the U.S. Environmental Protection Agency found that 47 percent of homes with children under 5 had at least one toxic pesticide stored in an unlocked cabinet, less than 4 feet off the ground (i.e., within the reach of children). And almost 75 percent of homes without children under 5 also stored pesticides in an unlocked cabinet, less than 4 feet off the ground.

Pesticides at daycare and school put children at potential risk. A 2006 U.S. EPA

NYS Snapshot

New York (along with MA and CA) is one of only three states nationwide with pesticide registries. In compliance with Article 33, Title 12 of the Environmental Conservation Law, the Pesticide Management Program of the Division of Solid and Hazardous Materials provides an annual report of pesticide sales and applications in NYS. Certified pesticide applicators and technicians are required to report the name of the product applied, the product's federal EPA registration number, the quantity applied, the date of application, the county, street address, municipality and zip code of the application (33).The database is maintained at Cornell University under contract to the State Department of Environmental Conservation and annual reports on NYS pesticide sales and use are available at http://pmep.cce.cornell.edu/psur/index.html

In 2005 commercial pesticide applicators in NYS applied 17,560,974 pounds (2,818,640 gallons) of chemical pesticides. This reflects an increase, up from a reported application in 2001 of 16,933,247 pounds (34). Pesticides were applied in most significant amounts in 2005 in Suffolk, Westchester, Nassau, Erie and Monroe Counties (34) (See figure 4.5)

In NYS, children's exposure to pesticides has been reduced subsequent to passage of Chapter 85 of the Laws of 2010 which has practically eliminated the use of pesticides on school athletic fields and playgrounds and day care centers

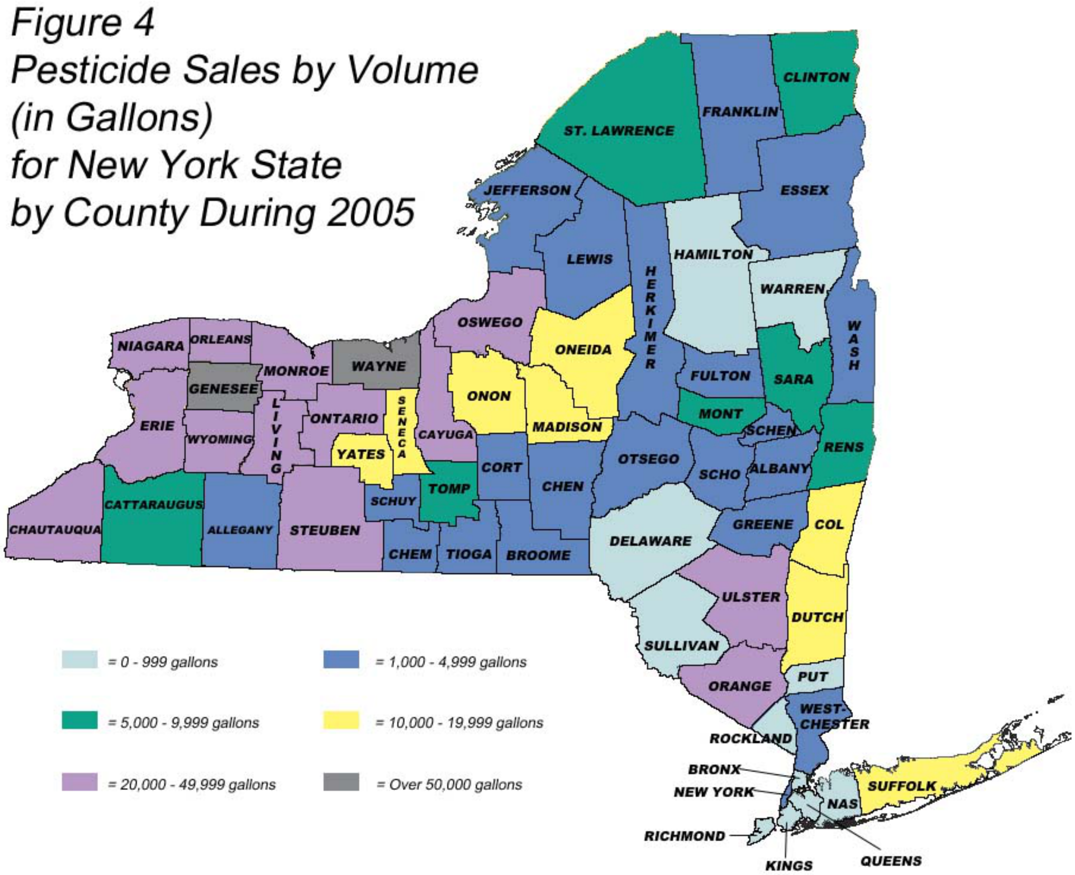
Pesticide use in NYC has declined following widespread adoption of Integrated Pest Management (IPM) in public housing

Over 1400 cases of pesticide poisoning were reported to the NYS Pesticide Poisoning Registry in the ten-year period from 1998-2007. Of those, 20% were children. Typically, these pesticide poisoning cases occurred when pesticides were not stored or applied in appropriate ways.i
In August 2000, a NYS law, Chapter 285, was enacted requiring prior notification of certain pesticide applications statewide at schools (grades K-12) and licensed, registered daycare centers. The law also includes provisions for requiring notification of certain commercial and residential lawn care pesticide applications, but only where local laws have been adopted (36)

Under this law, licensed and registered day care centers in the state must provide at least 48 hours prior notice of pesticide applications at their facility. Notice must be posted in a common area, where it can be easily seen by people picking up and dropping off children (37)

The state Education Department's RESCUE Regulations require all schools to have integrated pest management plans. The RESCUE regulations require schools to adhere to a process for resolving environmental health and safety problems, including establishment of school district health and safety committees as well as an annual school facility report card, which must include the status of the district's integrated pest management program.

Figure 4.5. NYS Pesticide Sales



Source:
2005 Pesticide Reporting Law Annual Report, NY State Dept of Environmental Conservation

study found at least one toxic chemical at every day care center examined, and found that these chemicals were used up to 107 times annually (28). A large variety of pesticides were used, with centers employing up to 10 different kinds. The most commonly found pesticides were chlorpyrifos, diazinon and permethrin.

Health Effects of Pesticides

Certain pesticides such as organophosphates, carbamates and pyrethroids are toxic to the brain and central nervous system. They have been shown to cause significant brain damage, particularly following perinatal exposure. Prenatal exposures to these compounds lead to learning disabilities and disruptive behavior in children.

A study of the impact of prenatal exposure to the organophosphate insecticide chlorpyrifos on neurodevelopment in the first three years of life among inner-city children in New York City found that the proportion of three-year-olds showing delayed development was five times greater in the group most heavily exposed (29). A follow-up steady of these children found that prenatal; exposure to chlorpyrifos was correlated with increased incidence of Pervasive Developmental Disorder (PDD), a form of autism.

Children exposed to a variety of pesticides in an agricultural community in Mexico showed impaired stamina, coordination, memory, and ability to represent common, familiar subjects in drawings (30). A study in Colorado found that the use of herbicides and insecticides cause neurological damage and that poisoning decreased concentration and triggered irritability (31).

Since head lice infestations in children are frequently associated with schools, children may come into contact with products, such as hexachlorobenzene (Lindane), a synthetic pesticide used as a treatment for head lice and scabies. Available in creams, lotions, and shampoos, the organochlorine pesticide can cause persistent changes in neural activity (32).

Polychlorinated Biphenyls (PCBs)

The PCBs are a class of 209 synthetic halogenated hydrocarbon compounds. They are widely disseminated in the environment of New York State. The commercial PCBs that are the source of most of today's pollution were produced as oily liquids (37).

Industrial use of PCBs began in 1929. Because of their extreme stability, non-flammability and resistance to heat and chemicals, PCBs were used widely in power plants and other industries as insulating fluids in electrical transformers and capacitors. PCBs were also used in consumer products such as hydraulic fluids, immersion oil for microscopes, carbonless copy paper, electrical appliances and fluorescent lighting ballasts. In the United States, because of growing concerns about their toxicity and environmental persistence, the Congress banned the manufacture and use of PCBs under the Toxic Substances Control Act of 1977. PCB production was banned internationally in 2001 under the Stockholm Convention on Persistent Organic Pollutants (POPs).

NYS Snapshot

To protect consumers against PCBs in fish, NYS issues annual advisories on consumption of sport-caught fish, particularly for fish caught in the Hudson River.

Dredging of the Hudson River PCB Superfund Site, with the goal of removing approximately 2.65 million cubic yards of PCB-contaminated sediment, is in progress and is currently in its fourth year (37)

For school buildings constructed or renovated between 1950 and 1977 and undergoing current renovation or demolition, New York State Education Department (NYSED) and New York State Department of Health (NYSDOH) recommend that the building(s) be evaluated prior to the renovation work to determine whether they contain caulk that is contaminated with PCBs. If contamination is found, an abatement plan is to be developed to address potential environmental and public health concerns (39, 40)

In New York City, the NYC School Construction Authority (SCA) has an active program for removal of old fluorescent light ballasts containing PCBs (41, 42)

Although PCBs have not been manufactured in the United States for over 30 years, they remain widespread in the environment as a consequence of their extensive past use, improper containment and environmental stability. The US Environmental Protection Agency (EPA) has estimated that 150 million pounds of PCBs were dispersed in air and water in the US and an additional 290 million pounds discarded into landfills.

Once released into the environment, PCBs degrade only very slowly and therefore may persist for decades. The most heavily chlorinated PCBs are generally the most highly persistent. They can cycle between air, water, and soil, and PCB vapors can be transported long distances in the atmosphere. Very high concentrations are found in the circumpolar regions as a consequence of long-range atmospheric transport.

Many waterways in the US and in other countries are contaminated today with PCBs. The Hudson River is contaminated with PCBs from above Albany to the southern tip of Manhattan as the result of leakage of PCBs from General Electric manufacturing plants. PCBs have been detected in sediment, water, fish and other aquatic species along the entire length of the river. Studies monitoring changes in levels PCB contamination in Hudson River sediments over time have shown that PCBs degrade only minimally in nature and that the river is not becoming cleaner.

Sources of PCBs

Consumption of contaminated food, especially fish, but also meat and dairy products is the most important exposure pathway for PCBs. Fish consumption is of particular importance because PCBs bioaccumulate in the food chain to reach high concentrations in predatory fish species in contaminated bodies of water such as the Hudson River (37).

Infants and children can be exposed to PCBs prenatally via transplacental transfer and postnatally via consumption of contaminated breast milk (5). Other sources of human exposure include exposure to PCBs in old fluorescent light fixtures and electrical devices manufactured prior to 1977 and breathing air near hazardous waste sites. Workers can be exposed occupationally through handling, accidental spills, leaks and disposal of PCB-containing devices.

For children living in older homes or attending school in older buildings, caulking materials represent another potential source of PCB exposure. Studies have shown that concentrations of PCB can exceed 1% (10,000 ppm) by weight in some caulk materials found in schools and other buildings constructed prior to 1977 (38). Renovation or maintenance work can disturb this caulking and lead to harmful levels of PCB exposure, as well as dangerous levels of PCBs in the surrounding soil.

Health Effects of PCBs

Learning disabilities, attention deficit/hyperactivity disorder, memory impairment, psychomotor dysfunction, deficiencies in immune system and reproductive system have all been observed in animal and human studies as consequences of PCB exposure. Prenatal exposures have the most significant effects. One study found that in utero exposure to a maternal serum PCB level of 9.7 ppb impaired brain development with resulting attention and IQ deficits that appeared to be permanent (39). PCBs are also known endocrine disruptors and impact thyroid hormones essential for normal brain development. PCBs have been shown to alter thyroid function during critical periods of brain development (40).

The International Agency for Research on Cancer, National Cancer Institute, U.S. Environmental Protection Agency, Agency for Toxic Substances and Disease Registry, World Health Organization and National Institute for Occupational Safety and Health all classify PCBs as probable human carcinogens.

Polybrominated Diphenyl Ethers (PBDEs)

Polybrominated diphenyl ethers (PBDEs) are a group of chemicals used as flame retardants. They have been used extensively in consumer and industrial products, specifically plastics and textiles. Unfortunately, like PCBs, these chemicals are persistent in the environment. A growing body of evidence indicates that they are dangerous to humans and especially to infants and young children.

NYS Snapshot

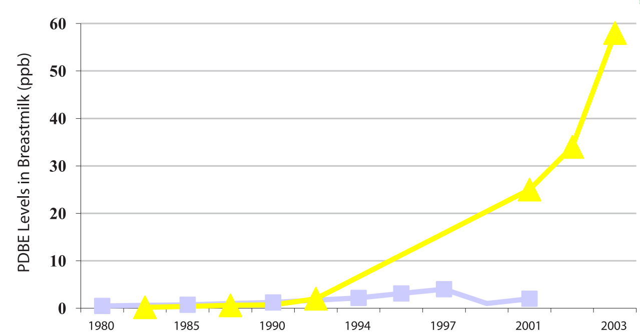
In 2004, the New York State Legislature passed a law banning the use of penta- and octa-BDE (48)

The same bill established a Taskforce on Flame Retardant Safety to study the risks associated with deca-BDE and determine the availability of safer, cost- and performance-effective substitutes for it. The Taskforce released its report to the New York State legislature in March 2013 (48)

Three kinds of PBDEs with differing uses have been introduced to commerce. Penta-BDEs are used as flame retardants in mattresses and furniture; Octa-BDEs are used in products such as business equipment, telephones, kitchen appliances; and Deca-BDEs are used in electronic enclosures, such as wire insulation, televisions and computers and as fabric treatments on carpets and draperies (43).Penta- and Octa-BDEs have not been produced in the United States since 2004, when their manufacture was voluntarily phased out. Deca-BDEs continue to be produced and used in this country (42). PBDEs are similar in their molecular structure to PCBs.

Concentrations of PBDEs have been increasing rapidly in recent years in the US in the environment as well as in human tissues. Concentrations in both humans and wildlife in North America have been doubling approximately every 2 to 5 years (44). No similar increase has been observed in Sweden where manufacture of PBDEs is banned.

Figure 4.6. PBDE in Breast Milk—North America and Sweden, 1980-2003



Compiled from data presented in: Fredericksen M, Vorkamp K, Thomsen M, Knudsen LE. (2009). Human internal and external exposure to PBDEs—A review of levels and sources. *International Journal of Hygiene and Environmental Health*. 212 (2), 109-34.

Sources of PBDEs

The general public is primarily exposed to PBDEs through the use of consumer products. PBDEs have been found in home and office dust, indoor air, plant and animal-based foods, terrestrial and marine animals, human breast milk, blood, and fat. PBDEs are persistent in aquatic ecosystems with relatively high levels being found in some fish. Recent studies have suggested that, particularly in the case of Americans, who bear a significantly higher burden of PBDE exposure than Europeans, the most significant exposure comes via house dust, either ingested or absorbed through the skin (45). High levels of PBDEs in house dust represent a particular risk for children, who absorb and ingest more dust through day-to-day activity than do adults.

Health Effects of PBDEs

PBDEs show toxic effects and physiologic impacts similar to those of PCBs. These effects include developmental and nervous system toxicity, as well as mimicry of estrogen and interference with the activity of thyroid hormone (46). In studies examining the carcinogenic effects of PBDEs, increased incidence of some cancers were observed in mice at high doses.

Neurobehavioral effects were seen in adult mice after single low dose exposures given during the neonatal period of brain development. Humans exposed occupationally were found to have hypothyroidism and decreased sensory and motor neurons.

A recent prospective epidemiologic study in New York City of infants exposed prenatally to PBDEs fond that children with higher concentrations of BDE 47, 99, or 100 scored lower on tests of mental and physical development at 1-4 and 6 years than children with lesser exposure. Associations were significant for 12-month Psychomotor Development Index (PDI) (BDE-47), 24-month Mental Development Index (MDI) (BDE-47, 99, and 100), 36-month MDI (BDE-100), 48-month full-scale and verbal IQ (BDE-47, 99 and 100) and performance IQ (BDE-100), and 72 month performance IQ (BDE-100). These associations were still evident after adjustment for potential confounders (47).

Asbestos

Asbestos is a term applied to six naturally occurring fibrous minerals. Specific minerals included under the term asbestos are chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, and actinolite asbestos (49). Chrysotile, also known as white asbestos, accounts for 95 percent of the asbestos ever used around the world, and it is the only type of asbestos in commercial use today.

NYS Snapshot

Because of the extreme hazard that it poses to human health, asbestos is very strictly regulated in New York State. New York State Regulations 12 N.Y.C.R.R. Part 56 and 10 N.Y.C.R.R. Part 73 address the removal of asbestos from public places and the appropriate training required for people working with asbestos generally.

The New York State Department of Health Asbestos Safety Training Program regulates asbestos safety training and training providers (51).

All of the asbestos minerals consist of fibers that are long, thin, and flexible. These fibers resist heat, fire and acid, properties that make them suitable for spinning and weaving into strong, fireproof materials useful for numerous commercial and industrial purposes, including insulation, wallboard and other construction materials, automotive brakes, and textile products, among others. Some 3000 different types of commercial products are estimated to contain asbestos (51).

When handled or otherwise disturbed, asbestos fibers can separate into microscopic particles that can become airborne and are easily inhaled deep into the lungs. The durability of the fibers makes them particularly hazardous to human health, since once they enter the lung tissue, they remain there for a long time (50).

Sources of Asbestos

Although the use of asbestos and asbestos products has dramatically decreased (many commercial uses for the material were banned in the 1970s), asbestos-containing materials are still found in many school buildings as well as residential and commercial settings, where they continue to pose a health risk to children, teachers and other school employees. In schools and other buildings, asbestos is often found around pipes, in insulation, boilers and in floor and ceiling tiles. Remodeling or other types of construction can disturb asbestos fibers that are already in the building and cause them to be released into the air where they can be inhaled (5) Asbestos exposure can also occur through ingestion of contaminated soil, or contaminated drinking water (50).

Health Effects of Asbestos

Inhalation of asbestos fibers can cause serious health effects. All forms of asbestos are now understood to cause asbestosis, a progressive, debilitating fibrotic disease of the lungs. All forms of asbestos cause malignant mesothelioma, lung, laryngeal, and ovarian cancers, and may cause gastrointestinal and other cancers. Asbestos has been declared a proven human carcinogen by the US Environmental Protection Agency (EPA), the International Agency for Research on Cancer (IARC) of the World Health Organization, and the National Toxicology Program (NTP). The scientific community is in overwhelming agreement that there is no safe level of exposure to asbestos. There is no evidence of a threshold level of asbestos exposure below which there is no risk of mesothelioma.

Asbestos-related diseases typically develop many years after exposure to the fibers; therefore, they are rarely seen in children. However, because the lag time between exposure and illness can be as long as 40 years or even longer, it is reasonable to expect that young people who are exposed to asbestos will be more likely to suffer from asbestos related disease within their lifetimes than those exposed at an older age. It is also possible that children are especially vulnerable to asbestos exposure, since they have different lung structure than adults and breathe differently (5).

Existing Laws on Asbestos

There are federal, state and local laws to reduce the risk of asbestos exposure in schools. The Asbestos Hazard Emergency Response Act (AHERA) 15 U.S.C. 2651 is a federal law. Regulations developed under AHERA may be found in Title 40 Code of Federal Regulations (C.F.R.) Part 763. These regulations specifically discuss the management of asbestos-containing materials in schools. Depending on its condition, location and accessibility to children, asbestos in a school may not necessarily need to be removed, but instead can often be left in place behind a secure barrier and managed in a safe manner. Every school must produce an AHERA report (5)

Volatile Organic Compounds

Volatile Organic Compounds (VOCs) are chemicals that evaporate easily at room temperature—entering the air as gases from their previous solid or liquid form. Some common VOCs are benzene, toluene, methylene chloride, formaldehyde, xylene, ethylene glycol and 1, 3-butadiene (52). Once they are airborne, VOCs can be inhaled.

VOCs emitted from motor fuels are a major contributing factor to the development of ground-level ozone, a serious air pollutant that can cause a range of respiratory disorders and other health problems (53). VOCs often have odors, although not always.

Sources of VOCs

There are thousands of different VOCs produced and used in the modern environment. A wide range of products have ingredients that emit or "off-gas" VOCs such as paints and paint thinners; cosmetic products such as nail polishes, colognes, and hairsprays; cleaning products, solvents, and air fresheners; adhesives; dry-cleaned clothing; pressed-wood products; and upholstered furniture (54). Some of these products (nail polish, for instance, or cleaning solvents) emit VOCs for a brief period of time during their use; the chemicals then dissipate as fresh air enters the space. Others (such as some carpeting or pressed-wood furniture) can emit the VOCs continuously over a long period of time.

Concentrations of VOCs are consistently up to 10 times higher in indoor than in outdoor air. Additional studies have found that certain VOCs average two to five times higher in indoor air than outdoor air and that immediately after using certain products, such as paint stripper, studies have found that VOCs may be 1,000 times higher than background outdoor levels (55).

NYS Snapshot

Under authority of the federal Clean Air Act, standards have been set regulating VOC emissions in consumer and commercial products.

Neither NYS nor the federal government has set standards for VOC levels in non-occupational settings, including schools, although guidelines are available.

A New York State Department of Education regulation specifically addresses the right to a well-ventilated room. 8 New York Code of Rules and Regulations (N.Y.C.R.R.) 155.1(b)(3)(ii) states that each teaching space should have a constant supply of fresh air to avoid the problem of odor, toxins and dust build up.

The New York City Health Code, section 45.11 requires that each school room should be properly ventilated, but not so well-ventilated as to cause drafts. 8 NYCRR 155.3(d) covers rules for heating and ventilating and air conditioning for non-Big City schools in the state.

Regulations of the New York State Commissioner of Education, Part 155 (8 NYCRR 155) address several areas of indoor air quality in schools. Also known as the RESCUE (REbuild SChools to Uphold Education) regulations, they require schools to have an indoor air quality management plan; generally require schools to have a controlled supply of fresh air and have sufficient air changes to produce healthful conditions and avoid odors or build-up or concentrations of toxic substances or dust particles and provide for specific protections to protect air quality during school construction and renovation projects.

The New York State Department of Environmental Conservation monitors ambient air quality, including VOC levels, throughout the state via the Toxics Monitoring Network. The purposes of this monitoring is to measure VOCs in industrial, residential, and rural settings; track changes in air quality in relation to VOC emissions; and to track industry in its efforts to reduce or control VOC emissions.

Health effects of VOCs

Acute symptoms of VOC exposure include eye irritation/watering, nose and throat irritation, headaches, nausea and/or vomiting, dizziness, asthma exacerbation, allergic skin reactions, memory impairment, and visual disorders (55). Severe health effects of VOC exposure can include damage to the liver, kidneys, and central nervous system. Some VOCs, among them benzene, formaldehyde and 1,3-butadiene, are known carcinogens (53).

The severity of the reaction to VOCs will depend on the chemical itself—some are known to be highly toxic while others have no known health effects —as well as on the level and duration of exposure. People with respiratory problems such as asthma, young children, the elderly, and people with heightened sensitivity to chemicals may be at increased risk from VOC health effects. Increased airways reactivity has been reported among persons in proximity to deodorizers and air fresheners that release VOCs to the indoor environment (52).

Exposures to VOCs during pregnancy have the potential depending on dose and timing of exposure to cause a variety of neurobehavioral disorders including attention deficits, reduced IQ, learning and memory deficiencies (5). High-dose exposures in pregnancy to VOCs such as toluene, trichloroethylene, xylene, and styrene may cause learning deficiencies and altered behavior in offspring (5).

Endocrine Disruptors

Endocrine disruptors (EDs) are chemicals that interfere with the production, transport, metabolism, binding action and elimination of natural hormones in the human body.

Natural hormones are powerful chemicals secreted by the endocrine glands. They include growth hormone produced by the pituitary, thyroid hormone, insulin produced in the pancreas, estrogen and testosterone. These powerful chemicals carry messages from one cell to another throughout the body. They regulate growth, development, reproduction, aging and risk of cancer. Disruption of normal hormonal signaling can have profound effects on health.

Some endocrine disruptors are of natural origin, such as phytoestrogens found in soy. Most are synthetic chemicals. By interfering with the normal actions of hormones, endocrine disruptors interfere with communication among cells in the body. They can alter the tempo of growth and development, slow growth of the brain, accelerate onset of puberty, disrupt energy metabolism and increase risk of cancer (56).

The earliest recognized endocrine disrupting chemicals were drugs specifically designed to treat hormone imbalance. Diethylstilbestrol (DES), a drug with strong estrogenic properties administered to pregnant women until 1971 to prevent miscarriages, is one example. Female children of mothers who took DES during pregnancy were found to have a higher incidence of certain forms of ovarian and vaginal cancer.

Endocrine disruptors are manufactured in volumes of millions of pounds per year (57). They include phthalates, bisphenol A, perchlorate, certain pesticides, brominated flame retardants, certain metals and dioxins. These chemicals are widespread today in consumer products such as soaps, shampoos, perfumes and plastics. They are common contaminants in air, food and drinking water.

Endocrine disruptors can be found today in the bodies of nearly all Americans, including newborn infants, and in mothers' breast milk. Known and suspected EDs are found in products used every day by adults and children in New York state, including cosmetics, sunscreens, perfumes, soaps, surfactants; pesticides, and plastics such as PVC and polystyrene (57).

Currently there are no standard tests to determine if a particular chemical is an endocrine disruptor. Both the Clean Water Act and the Food Quality Protection Act (1996) required EPA to develop test methods. Data have, however, been submitted to US EPA by registrants and these studies are currently under review (57).

Sources of EDs

Concentrations of certain endocrine disruptors are magnified through bioaccumulation up the food chain. Concentrations of fat-soluble EDs in the adipose tissues of humans at the top of the food chain can be millions of times higher than concentrations in water. Humans can also be exposed to EDs through inhalation and through the skin. Humans are in direct contact with EDs at home, the workplace and school. Some EDs such as PCBs and DDT can persist in soil for years and can contaminate areas far removed from the area of concentration.

Health Effects of EDs

Both exposure dose and timing of exposure appear to be important determinants of the effects of EDs on health and development. In laboratory studies, endocrine disruptors have been shown to mimic, alter, magnify and block the effects of naturally occurring hormones. In wildlife, endocrine disruptors are linked to cancers and reproductive impairment (57).

In children, synthetic endocrine disruptors are linked to developmental disabilities of the brain and nervous system. Exposures to even very small levels of EDs in the early stages of human development can alter development and disrupt the function of various organ systems including the brain and reproductive organs. Reported consequences of early exposures to endocrine disruptors include:

> Prenatal exposures to polybrominated flame retardants (PBDEs) are associated in with diminished intelligence (47).
>
> Prenatal exposures to phthalates are associated with behavioral disruptions in children that resemble attention deficit/hyperactivity disorder (ADHD) (58).
>
> Prenatal exposures to phthalates have been associated with reproductive abnormalities in newborn baby boys that are indicative of partial feminization *in utero* (59).
>
> Prenatal exposures to Bisphenol A (BPA) are associated with decreased cognitive function and altered behaviors in children (60).
>
> Endocrine disruptors can interfere with energy metabolism in children and may play a role in the causation of obesity, which has more than doubled among US children as well as in the causation of type 2 diabetes (61).

Two groups of compounds with ED properties that are in especially wide use in New York are phthalates and bisphenol A (BPA).

Phthalates are a group of oily liquid chemicals used to make plastics soft and flexible. They are found in a wide range of both in-

NYS Snapshot

Legislation to ban the manufacture, distribution, and sale of toys and other children's products that contain phthalates is currently under consideration by New York State lawmakers (64)

See chapters on specific chemicals, including PCBs, PBDEs, BPA, and pesticides, for further detail on New York State regulatory action

dustrial and consumer products such as shower curtains, intravenous bags and previously in infants' pacifiers. They are powerful endocrine disruptors. Prenatal exposures to phthalates are associated with disrupted development of the brain and reproductive organs (59, 60).

Under the Consumer Products Safety Improvement Act (CPSIA) of 2008, three phthalates (DEHP, DBP, and BBP) have been permanently banned in concentrations greater than 0.1% in any children's toys or children's care articles. Three additional phthalates (DINP, DIDP, and DnOP), have been prohibited pending further study.

In December, 2009, the EPA released an action plan on phthalates, outlining the agency's intention to initiate rulemaking regarding eight specific chemicals of concern (62). In its action plan summary, the EPA stated: "Adverse effects on the development of the reproductive system in male laboratory animals are the most sensitive health outcomes from phthalate exposure. Several studies have shown associations between phthalate exposures and human health, although no causal link has been established. Recent scientific attention has focused on whether the cumulative effect of several phthalates may increase the potential reproductive effects in the organism exposed."

Bisphenol A (BPA) is an endocrine disrupting chemical most commonly used as a component of polycarbonate plastics—a hard plastic that is used to make everyday items including re-useable water bottles, food containers, tableware, storage containers, cans for food, epoxy resins, and in some dental sealants designed to prevent cavities in children. It is also used to create CDs, DVDs, sports safety equipment, and computers. BPA is used also to make epoxy resins. Epoxy resin linings coat the inside of metal products such as food cans, bottle tops, and water supply pipes. The purpose of epoxy linings is to keep the can material from corroding or reacting with the food.

Sources of BPA

Exposure to BPA most often comes via consumption of a wide variety of foodstuffs and beverages into which BPA has leached from packaging. BPA also enters the environment showing up in rivers, estuaries, and in sediment. As BPA does not readily degrade, it is a persistent environmental concern.

Children come into contact with BPA when they use hard plastic cups, tableware, and bottles for drinking and when they eat foods into which the chemicals have leached from epoxy-lined cans. In schools, exposure is likely to be associated with epoxy glues in classroom construction and materials, and in food and utensils provided in the cafeteria or from vending machines.

Some infants may have greater exposure to BPA than others because their diet may consist largely of infant formula from epoxy-lined cans. Infants may also be given infant formula and other liquids in polycarbonate baby bottles—although increasing awareness of the risks of BPA in the last few years has led many baby product companies to produce BPA-free versions of their bottles, sippy cups, and other products. Bisphenol A is also present at low levels in indoor air and dust, dental sealants, and other products.

Health Effects of BPA

BPA has been classified by the World Health Organization and the Environmental Protection Agency as a carcinogen. In mice, BPA has been shown to cause errors in cell division that lead to miscarriage and birth defects (63)

Mold

Molds are species of fungi. They are ubiquitous and especially thrive in warm, damp conditions. Molds reproduce by producing spores that spread through air or water, or are carried by insects. Mold will grow and multiply under the right conditions, needing only sufficient moisture (i.e., in the form of very high humidity, condensation, or water from a leaking pipe, etc.) and organic material. Many materials found in homes, including ceiling tile, drywall, paper, or natural fiber carpet padding make ideal hosts for mold growth (66).

Sources of Mold
Common sources of moisture that stimulate the growth of mold include a leaking roof, flooding, drainage problems, plumbing leaks, damp basements or crawl spaces, bathroom or kitchen steam, humidifiers, and poor or improper ventilation. Inadequate maintenance and enough moisture will allow molds to spread on ceilings, behind and on walls, on floors and carpets, and in books and other water absorbing materials. Indications of a moisture problem may include discoloration of the ceiling or walls, warping of the floor, or condensation on the walls or windows. Mold spores are small enough to remain airborne and enter the respiratory system through inhalation. Mold was a severe problem in coastal areas of New York State in 2012 and 2013 in the aftermath of Hurricane Sandy.

Modern building construction methods are partially to blame for the widespread mold problems in the U.S. today. The combination of energy-efficient designs that limit circulation of fresh air, together with poor building materials susceptible to mold infiltration and poor construction controls create conditions in which mold can thrive (67). According to EPA, up to half of all the nation's 125,000 schools have problems with Indoor Air Quality (EPA IAQTfS), and those problems have frequently been linked to mold and mildew (68).

NYS Snapshot

There currently exists no statewide public health law in New York with regard to mold.

The New York State Legislature, established a Toxic Mold Task Force in under Public Health Law Title 11A, Section 1384 which became law in 2005. The Task Force was assigned the responsibility of assessing the adverse environmental and health effects of mold exposure, including specific effects on population subgroups at high risk (74)

The Task Force issued its final report in December 2010. This report presents 10 separate recommendations across 6 major topic areas. Among these was a recommendation to State agencies that they should seek to improve the quality of mold assessment and remediation work done in the State by developing guidance or regulation on mold assessment and remediation. The Task Force also recommended that State agencies should provide guidance about recommended work practices and about the existence of training curricula and certification (75)

The Task Force noted that local agencies have an important role to play in control of mold by enforcing the State Uniform Fire Prevention and Building Code and the State Energy Conservation Construction Code (and analogous New York City codes). The Task Force noted that these are the mechanisms that New York State uses to prevent or minimize moisture problems in buildings through design, construction and property maintenance requirements (75)

Health Effects of Mold
Exposure to mold can cause allergies, cause new-onset asthma and trigger asthma attacks and increase susceptibility to colds and flu. Common symptoms include congestion, runny nose, coughing, and irritated eyes; new or worsening asthma; flu symptoms; headaches and, fatigue. Other symptoms that have been reported following exposures to mold, but there is inadequate or insuffi-

cient evidence of any causal association (69-72).

Molds, dead or alive, can provoke allergic reactions in sensitive individuals. People who live or work in very damp, moldy environments can become sensitized due to chronic exposures and develop chronic inflammation (73). Infants and young children appear to be at particularly high risk of mold exposure.

Toxic Emissions, Hazardous Waste Sites & Brownfields

Toxic emissions to the environment are extensive in New York State. They are tracked by the Toxics Release Inventory (TRI), a publicly available database that was established in 1986 by the US Congress through the Emergency Planning and Community Right-to-Know Act (EPCRA) and is maintained and updated by US EPA. An industrial facility must report its environmental releases to the Toxic Releases Inventory if it manufactures or processes 25,000 pounds or more or uses 10,000 pounds or more of a listed toxic chemical during a calendar year (76).

In 2012, industrial facilities in New York State released a total of 17,257,529 pounds of toxic and hazardous materials to the environment (77). New York ranks #26 among the states in total pounds of hazardous chemicals released to the environment (78). These releases are sorted by their health effects in Table 4.2. The four counties in New York State with the largest volumes of environmental releases are: Monroe, Niagara, Erie and Onondaga.

Table 4.2. New York State Toxic Release Inventory (TRI) Releases by Health Effect

Class of Chemicals	Air Releases (Pounds from TRI sources)	Water Releases (Pounds from TRI sources)
Recognized Carcinogens	1,754,254	80,794
Suspected Carcinogens	334,315	70,321
Suspected Cardiovascular or Blood Toxicants	8,516,380	6,181,157
Recognized Developmental Toxicants	2,854,486	32,223
Suspected Developmental Toxicants	5,009006	126,768
Suspected Endocrine Toxicants	2,279,654	17,906
Suspected Immunotoxicants	14,447,204	189,032
Suspected Kidney Toxicants	7,395,786	180,840

Adapted from:
http://scorecard.goodguide.com/env releases/state.tcl?fips_state_code=36#pollution_rank_health_impact

The five chemicals most heavily emitted to the environment by New York State industry are nitrates, hydrochloric acid, carbonyl sulfide, polychlorinated biphenyls and barium compounds. In Monroe

County, nitrate compounds, hydrochloric acid, zinc compounds, sulfuric acid and methanol are the five leading chemicals. In Niagara County, polychlorinated biphenyls, lead compounds, barium compounds, copper and hydrochloric acid were the most significant environmental releases. In Erie County, carbon disulfide, barium compounds, methyl methacrylate, di (2-ethyhexyl) phthalate and ethylene glycol were the top chemicals. In Onondaga County, nitrate compounds were most often released. There is clearly great diversity in patterns of environmental releases across New York State.

NYS Snapshot

New York ranks #26 in the nation in pounds of chemicals released by industry. In 2012, according to EPA's Toxic Release Inventory, more than 17 million pounds of toxic chemicals were released into the air, water, and land in the State.

Patterns of toxic release are highly variable across the State reflecting different patterns of industry in different regions.

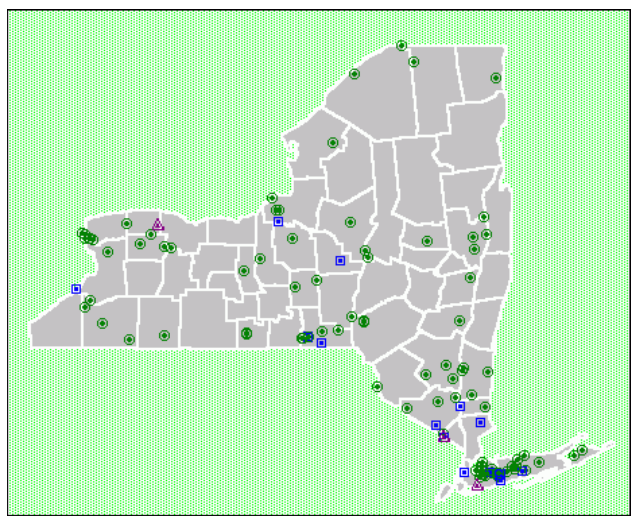
Locally tailored strategies will be required to protect children in different areas across New York against environmental hazards.

Hazardous Waste Sites—defined as any areas containing chemical waste in solid, liquid, gas or sludge form—pose major threats to the environment and to public health. Hazardous wastes can pollute soil, groundwater and surface water, and their vapors can contaminate the air. Hazardous waste sites are subject to fire and explosion. Eleven million people across the United States live within 1 mile of a federal Superfund site (79).

Over two-thirds of hazardous waste sites in the United States consist of landfills and former industrial properties. Some of these are abandoned, some are illegal, and a few are both illegal and abandoned. They include waste recycling facilities, mines and smelters, military facilities and nuclear facilities. Hazardous wastes at these sites include discarded industrial and manufacturing wastes such as solvents; source-specific wastes from industries such as petroleum refining and pesticide manufacturing; and discarded commercial chemical products (80).

Enormous increases in production of hazardous wastes have occurred in the United States and globally in recent decades. This increase reflects exponential increases in petrochemical production and in the manufacture of chemical-based consumer products.

Figure 4.7. Map of National Priority List Superfund Sites in NYS



Adapted from: http://www.scorecard.org/env-releases/land/state.tcl?fips_state_code=36#maps

EPA maintains a national listing of hazardous waste sites—the National Priorities List (NPL)—under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), known as the Superfund Act. Across the United States, more than 15,000 hazardous waste sites have been identified, and 1,313 of those sites are currently included on the NPL. Another 372 sites have been remediated under EPA's direction and removed from the NPL. Fifty-four new sites are proposed for listing (81).

As of October, 2013, there were 87 Superfund sites on the NPL located in New York State (Figure 4.6). Two new sites have been proposed for addition to the list, and 26 sites have been deleted from the list following cleanup.

In New York State, the Department of Environmental Conservation (DEC) has promulgated extensive rules for the remediation of hazardous waste sites and brownfields under 6 NYCRR Part 375. This rule-making extensively considered hazardous exposures to children. DEC had identified 2,317 hazardous waste sites by the end of March, 2009 that are in need of evaluation. Most of these sites are not on the NPL. Of those sites, 1,428 had been remediated or were determined to require no further action. Action on the remaining 889 sites is still pending (82).

Brownfields are defined by the New York State Department of Environmental Conservation (DEC) as any property where redevelopment or re-use may be complicated by the presence or potential presence of a hazardous waste, petroleum, pollutant, or contaminant (83).

In 2003, New York State established the Brownfield Cleanup Program (BCP) to encourage private sector remediation and development of brownfield sites and to reduce the developmental burden on "greenfields"—non-contaminated real property. The program provides resources as well as tax credits for cleanup efforts (84). The program was updated in 2008 to limit redevelopment tax credits available for individual projects and to provide greater incentives for more rigorous cleanups (85).Recent proposals from DEC, aimed at streamlining the process of brownfield cleanup by allowing certain properties to pre-qualify for inclusion in the BCP and by shortening the time frame from application approval to execution of a cleanup agreement with the state, are currently under consideration.

NYS Snapshot

The U.S. Environmental Protection Agency has designated 87 hazardous waste sites in New York State for cleanup through the federal Superfund program as of March 31, 2009 (81)

The New York State Department of Environmental Conservation (DEC) had identified 2,317 sites by the end of March, 2009, most of which are not on the national Superfund Registry, that are in need of evaluation (82)

DEC's Environmental Site Remediation Database lists 270 sites currently in the state's Brownfield Cleanup Program (83)

Proposals DER-10 and DER-30, currently under consideration by DEC are intended to streamline the qualification and application process for proposed brownfield sites with the goal of expediting cleanup (84, 85)

Built Environment

The term "built environment" refers to constructed spaces such as buildings, streets, cities and towns as well as outdoor spaces such as parks and playing fields that have been altered by human activity. Increasing research links factors in the built environment to the state of children's health (86).

Many of the structural features of the urban built environment—its enormous size, its large and densely clustered population, its social institutions, its psychosocial stressors, its economy, its rapid pace, its violence, the configuration of its streets, parks, schools, and play spaces—affect children's health, growth, and development. Specific connections have been reported between the built environment and children's lung function (mediated by air pollution) and risk of obesity (mediated by sedentary lifestyles) (87).

The adverse effects of the urban environment are especially magnified in low-income, predominantly minority communities where crowded streets, lack of safe outdoor play spaces, limited access to fresh and healthy food, and substandard housing all contribute to substantial and well-documented disparities in child health. Environmental injustice—the inequitable and disproportionate location of polluting industries, hazardous waste sites and major highways in poor and minority urban communities—is another common feature of the built environment. Disproportionate exposure of children in such communities to noise and pollution can impair their health and their ability to learn (88).

In suburban and rural communities, environmental factors contribute to childhood overweight and obesity in different ways. As cities move outwards to encroach upon neighboring fields and woodlands, the phenomenon of urban sprawl is becoming common. Urban sprawl is characterized by low-density land use, separation of homes from other land uses such as stores and schools, and low "connectivity" along surface roads. In the United States and other developed countries, people are relying more and more on cars to get from place to place instead of walking or taking public transportation. Too many suburban towns have no sidewalks and no safe bicycle paths (89).

Additional environmental risk factors that may influence risk of obesity include a food environment that poses increased exposure to high-calorie fast foods, "junk" foods, and refined sugars (90). Low-income families must often depend on smaller stores that have a limited selection of fresh foods, often at relatively higher cost. The presence of a supermarket within a census tract is associated with a 32 percent increase in fruit and vegetable intake compared to neighborhoods without supermarkets. Supermarkets have twice the amount of healthy foods as neighborhood grocery stores and four times that of convenience stores. Yet there are four times as many supermarkets located in white neighborhoods as there are in black neighborhoods (91)

Environments that support recreational opportunities for children and adolescents can help to combat obesity. The physical layout of communities can promote or limit opportunities for physical activity. Although parks do not guarantee physical activity among nearby residents, they offer the opportunity. In an experimental study in which children were made to decrease their time spent being sedentary, they increased the time spent engaged in physical activity, and the extent of increase was associated with proximity to a park. Children living in low-income or predominantly minority neighborhoods may have less access to parks or other recreational facilities.

Local communities have created parks and playgrounds in previously unused areas. Nonprofit organizations, such as the Trust for Public Land, have helped communities by assisting them in tasks ranging from park siting to development of funding strategies. Between 1971 and 2002, the Trust for Public Land's work in US cities resulted in the acquisition of 532 properties totaling 40,754 acres of newly created public land. Legislative efforts are also an important mechanism to fund park development and maintenance (92).

The New York State Department of Health has made the built environment a prevention agenda focus area under the heading of Healthy and Safe Environment (93).

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Schools—Where Children Learn and Play

Children spend at least 6-8 hours per day at school. Schools contain numerous, often poorly regulated environmental hazards that can affect the health of children. Given the duration of time that children spend at school, understanding of the environmental hazards they confront at school is important.

Schools and Asthma

The school environment poses significant risks for asthma-prone children. Pollutants such as industrial carpeting, pesticides, cleaning chemicals, molds, and diesel emissions from school buses all contribute to asthma symptoms (1). Diesel emissions in particular constitute a major contributor to the high rates of asthma symptoms among school-age children. In a recent, five-year study by researchers at New York University's School of Medicine and Robert F. Wagner Graduate School of Public Service, asthma symptoms, particularly wheezing, were found to double among elementary school children on high traffic days. Large numbers of those children attended schools near busy truck routes (2).

New York State regulation specifically requires that each teaching space should have a constant supply of fresh air to avoid problems of odor, toxins and dust build up. In addition, the New York City Health Code, section 45.11 requires that each school room be properly ventilated, but not so well-ventilated as to cause drafts.

Regulations of the Commissioner of Education, known as the RESCUE (REbuild SChools to Uphold Education) regulations, require schools to have an indoor air quality management plan; generally require schools to have a controlled supply of fresh air and have sufficient air changes to produce healthful conditions and avoid odors or build-up or concentrations of toxic substances or dust particles and provide for specific protections to protect air quality during school construction and renovation projects.

The New York City Administrative Code specifically states that buses cannot leave their motors running for more than three minutes, and cannot leave them running at all when it is warmer than 40 degrees outside. In 2009, the idling limit was reduced to one minute in areas adjacent to schools.

Schools and Mercury

Children are at risk of exposure to metallic mercury in schools. Inhalation of mercury vapor is the principal route of exposure. According to a national alert issued to the general public jointly by the Agency for Toxic Substances and Disease Registry (ATSDR) and EPA, increasing numbers of metallic mercury spills have been reported in schools in recent years (3). Instruments containing mercury can be found widely on school property—in the nurse's office, science rooms, gymnasiums, art rooms and boiler rooms. Liquid mercury is used in instruments that measure temperature (thermometers), pressure (barometers or sphygmomanometers), humidity (hygrometers), vacuum (laboratory manometers), flow (water meters) and air speed (anemometers). Mercury can also be found in lights (particularly gymnasium and fluorescent lights), thermostats, heating/ventilation and air conditioning (HVAC) systems, plumbing systems, cafeteria equipment, medical devices, regulators, gauges, and science room equipment. At times, children or adults who are unaware of the health hazards bring mercury into schools to play with, for demonstrations or to use in cultural rituals (1).

In 2006, a case was reported in Franklinville, NJ in which a day care center was sited in a former mercury thermometer factory. Residual mercury contamination in the structure of the building led to elevated blood mercury levels in numerous children attending the day care center (4).

The New York State Health Department recommends that containers of elemental mercury identified by staff or found during an inventory be given the highest priority for removal. Should a spill occur, many individuals could be exposed, resulting in negative health effects, significant cleanup costs and widespread environmental contamination. Brochures are available on the Health Department website about mercury exposure in schools geared toward parents, students, science teachers, buildings and grounds personnel, health and safety committees, superintendents, school boards, principals and school nurses as well as action steps to take if a spill occurs and phone numbers to contact in the case of an emergency (5).

NYS Department of Environmental Conservation Law requires schools to identify and remove elemental mercury from school facilities.

Schools and Pesticides

Pesticides at daycare and school put children at potential risk. An October 2006 U.S. EPA study found at least one toxic chemical at every day care center examined, and found that these chemicals were used up to 107 times annually (6). A large variety of pesticides were used, with centers employing up to 10 different kinds. The most commonly found pesticides were chlorpyrifos, diazinon and permethrin.

The State Education Department's RESCUE Regulations require all schools to have integrated pest management plans. The RESCUE regulations require schools to adhere to a process for resolving environmental health and safety problems, including establishment of school district health and safety committees as well as an annual school facility report card, which must include the status of the district's integrated pest management program.

Licensed and registered day care centers in the state must provide at least 48 hours prior notice of pesticide applications at their facility. Notice must be posted in a common area, where it can be easily seen by people picking up and dropping off children (6).

Schools and PCBs

For children attending school in older buildings, PCB-containing caulking materials represent a potential source of PCB exposure. Studies have shown that concentrations of PCB can exceed 1% (10,000 ppm) by weight in some caulk materials found in schools constructed prior to 1977 (7). Renovation or maintenance work can disturb this caulking and lead to harmful levels of PCB exposure, as well as dangerous levels of PCBs in the surrounding soil.

For school buildings constructed or renovated between 1950 and 1977 and undergoing current renovation or demolition, New York State Education Department (NYSED) and New York State Department of Health (NYSDOH) recommend that the building(s) be evaluated prior to the renovation work to determine whether they contain caulk that is contaminated with PCBs. If contamination is found, an abatement plan is to be developed to address potential environmental and public health concerns (7).

Another recently identified source of PCBs in school buildings is old, PCB-containing ballasts for fluorescent lights. When these ballasts burst or leak, they can release PCBs to the school environment. After much debate, a decision has recently been made in New York City top remove old, PCB-containing ballasts from schools as soon as possible.

Schools and Asbestos

Although the use of asbestos and asbestos products has dramatically decreased (many commercial uses for the material were banned in the 1970s), asbestos-containing materials are still found in many school buildings as well as residential and commercial settings, where they continue to pose a health risk to children and employees. In schools and other buildings, asbestos is often found around pipes, in insulation, boilers and in floor and ceiling tiles. Remodeling or other types of construction can disturb asbestos fibers that are already in the building and cause them to be released into the air where they can be inhaled (1).

There are federal, state and local laws to reduce the risk of asbestos exposure in schools. The Asbestos Hazard Emergency Response Act (AHERA) 15 U.S.C. 2651 is a federal law. Regulations developed under AHERA may be found in Title 40 Code of Federal Regulations (C.F.R.) Part 763. These regulations specifically discuss the management of asbestos-containing materials in schools. Depending on its condition, location and accessibility to children, asbestos in a school may not necessarily need to be removed, but instead can often be left in place behind a secure barrier and managed in a safe manner. Every school must have an AHERA report.

VOCs in Schools

Neither New York State nor the federal government has set standards for VOC levels in non-occupational settings, including schools, although guidelines negotiated to protect adult workers are available.

Endocrine Disruptors in Schools

Children come into contact with BPAs when they use hard plastic cups, tableware, and bottles for drinking and when they eat foods into which the chemicals have leached from epoxy-lined cans. In schools, exposure is likely to be associated with epoxy glues in classroom construction and materials, and in food and utensils provided in the cafeteria or from vending machines.

Green Cleaning Products in Schools

New York State law requires all schools to use certified green cleaning products. These products minimize impacts on human health and the environment and reduce level of certain key pollutants such as VOCs relative to conventional institutional cleaning products.

Mold in Schools

Modern building construction methods are partially to blame for the widespread mold problems in the U.S. today. Energy efficient designs can lack adequate ventilation to keep moisture in check, and as a result mold thrives (8). Large buildings such as schools have been frequently cited for mold problems. According to one report, more than one in five of the nation's public schools have reported problems with indoor air quality, and more than half of those problems have been linked to mold and mildew (8).

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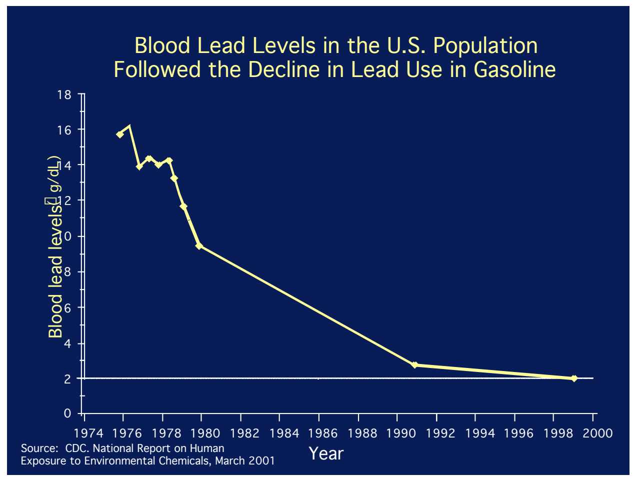
Prevention of Environmental Disease

Diseases of environmental origin are preventable. Diseases of environmental origin arise as a consequence of human activity. They can therefore be prevented by modification of that activity.

Primary prevention, the elimination of exposure to an environmental hazard at its source, is the most effective intervention against disease of environmental origin. It is far more efficient and effective than "secondary prevention", which seeks to control an exposure that has already been disseminated into the environment. In practice, the two approaches often complement each other.

The removal of lead from gasoline is a classic example of primary prevention (Figure). It resulted in a 90% reduction in blood lead levels in American children, a 90% reduction in incidence of childhood lead poisoning, a 2-4 point gain in the average IQ of American children, and an annual economic benefit of between $100 and $300 billion, which is mainly the result of the increased economic productivity that followed the gain in IQ. This is a success that has been replicated in many nations around the world.

Figure 6.1. Lead and Gasoline



Source:
Centers for Disease Control and Prevention.
Report on Human Exposure to Environmental Chemicals, 2001.
Atlanta, GA: U.S. Department of Health and Human Services,
Centers for Disease Control and Prevention.

Other examples of scientific discoveries that have successfully been translated into evidence-based programs of disease prevention include:

Reductions in the use of alcohol and tobacco during pregnancy. These programs have led to prevention of fetal alcohol syndrome and to prevention of intrauterine growth restriction caused by maternal cigarette smoking.

Minimization during pregnancy of diagnostic X-rays following the discovery that prenatal exposure to radiation increased risk of childhood leukemia.
Banning production of PCBs with subsequent reduction in the number of children who have suffered PCB-induced losses of intelligence.

Elimination of residential uses of neurotoxic organophosphate pesticides, with subsequent reductions in the number of babies with lowered birth weight and small head circumference.

Successful programs for prevention of environmental disease do not require full knowledge of the molecular mechanisms of disease. Each of the successful programs listed above was taken on the basis of partial, but compelling evidence and was explicitly intended to be precautionary.

Economic Costs of Environmental Disease in Children

The economic costs of disease in children caused by environmental health and safety threats are immense (1). These costs are potentially avoidable. They can be avoided through evidence-based prevention programs that reduce or eliminate exposures of children and pregnant women to environmental health and safety hazards.

The economic costs of childhood disease caused by toxic chemicals in the environment may be divided into 'direct' and 'indirect' costs (2).

> The 'direct' or medical costs include the costs associated with the provision of medical care to children with environmental illness—doctors' bills, hospitalization costs, ER and outpatient costs and medications.
>
> The 'indirect' or non-medical costs describe the economic burden placed on society by environmental disease and its consequences. For example, in the case of lead poisoning, analyses of indirect costs have focused mainly on the loss of intelligence that is caused by lead and on the lifelong decrement in economic productivity that results from this loss of intelligence. These costs are sometimes referred to as 'lost opportunity costs'. When exposure to a neurotoxic chemical is widespread in a society, as was exposure to lead in the US from the 1950s through the 1970s, the aggregate loss of intelligence and the resulting decrement in economic productivity across a society can be enormous. Some of these costs fall on the Medicaid budget, some on the Education budget, some on the Corrections budget, and some on the general budget of New York State.

Cost Analyses

A methodology for estimating the costs of diseases caused by environmental contamination was developed in the US in the early 1980s by an expert committee convened by the Institute of Medicine and chaired by Stanford University Nobel Laureate in Economics, Professor Kenneth Arrow (2). The core of this methodology is calculation of the "fractional contribution" of the environment to causation of a particular disease in a particular population. This environmentally attributable fraction (EAF) is defined as "the percentage of a particular disease category that would be eliminated if environmental risk factors were reduced to their lowest feasible levels." (3)

> The EAF for a particular disease, such as childhood asthma, may be converted to an estimate of the cost of that disease in a particular population through the following equation:
>
> Costs = Disease rate [incidence or prevalence] × EAF × Population size × Cost per case.
>
> Costs, as noted above, are traditionally divided into direct and indirect health-related costs, and both are included in the calculation.

The EAF model has now been used in a series of important cases to assess the costs of environmental and occupational disease. Findings from these analyses have had powerful impacts on the health and well-being of societies around the world.

In one of its earliest applications, the EAF approach was used in 1989 in New York State to estimate the fractional costs of four categories of illness attributable to occupational exposures—cancer, chronic respiratory disease, cerebrovascular and cardiovascular disease, and end-stage renal failure. This analysis found, using fairly conservative assumptions that occupational exposures resulting in these four diseases cost over 600 million US dollars per year, with the largest proportion (80%) due to occupationally related cancer (4).

This analysis persuaded the New York State Legislature to allocate funds to support a statewide network of clinical Centers of Excellence in occupational medicine to provide expert diagnostic and treatment services to workers who had been made ill or injured while at work.

Over the past 25 years these Centers of Excellence have provided previously unavailable specialist care in occupational medicine to tens of thousands of workers, and they have contributed striking reductions in incidence of occupational disease and death in New York State. These Centers of Excellence continue to the present day to provide medical care to injured and ill workers. They played a central role in supporting the medical response to the attacks on the World Trade Center in New York City of September 11, 2001.

Cost Analyses in Children's Environmental Health

The economic costs of disease caused in children by harmful exposures in the environment have been carefully examined. A 2002 report by Mount Sinai investigators (5) analyzed the costs in US children of four categories of pediatric illness for which there is published evidence for an environmental contribution: lead poisoning, asthma, cancer, and neurobehavioral disorders. In this analysis, data on incidence and rates of disease were taken from databases maintained by the Centers for Disease Control and Prevention (CDC) and the US National Institutes of Health (NIH). Data on the size of the population at risk for each disease were obtained from the US Census.

Table 7.1. Aggregate Costs of Environmentally Mediated Diseases in US Children, 2008

(All values in $ billions)

Condition	Best Estimate	High-End	Low-End
Lead poisoning	50.9	44.8	60.6
Methylmercury toxicity	5.1	3.2	8.4
Asthma	2.2	728.0	2.5
Intellectual Disability	5.4	2.7	10.9
Autism	7.9	4.0	15.8
AD/HD	5.0	4.4	7.4
Childhood cancer	95.0	38.2	190.8
Total	**76.6**	**59.8**	**105.8**

Adapted from:
http://scorecard.goodguide.com/env releases/state.tcl?fips_state_code=36#pollution_rank_health_impact http://score-

These estimates were updated, expanded and refined by the Mount Sinai team in 2011 (6). By incorporating new information on environmental causation of disease, expanding the number of disease categories considered and updating estimates on cost of illness, this updated analysis found that the annual costs of lead poisoning, prenatal methylmercury exposure, childhood cancer, asthma, and intellectual disability, autism, and attention deficit hyperactivity disorder in US children now amount to $76.6 billion US dollars (Table 7.1).

Because New York State includes 4.2 million (5.6%) of America's 73.7 million children under the age of 18 years, 5.6 % of these total costs of disease, or $ 4.35 billion each year fall upon New York's citizens and taxpayers, a high proportion of them on the State Medicaid budget. These are potentially avoidable costs.

The costs will likely become yet greater in the years ahead if children's exposures to inadequately tested chemicals are permitted to continue. Increased investment is required in tracking and surveillance, in basic studies of disease mechanisms, in prevention-oriented epidemiologic research and most importantly, in investments that will prevent harmful environmental exposures to the children of New York State.

NYS Snapshot

The direct plus indirect costs of illness of environmental origin in New York's children are currently estimated to amount each year to $4.35 billion.

Costs of environmentally attributable pediatric asthma in the New York's children were estimated in 2008 to be $125 million (7).

Total environmentally attributable costs of neurobehavioral disorders—including mental retardation, autism, and ADHD —are estimated each year to be $1.04 billion.

The costs of lead poisoning exceed $4 billion each year in New York. These costs include the costs of medical treatment plus the costs of special education, diminished economic productivity and incarceration in children exposed to lead.

On average, New York spends approximately $12,457 per pupil per year on special education services over and above normal education costs. This translates to an annual statewide expenditure of approximately $5.5 billion (8)

The estimated annual cost of environmentally attributable childhood cancer in New York State is $5.4 million.

Total obesity-related medical expenses in New York top $6 billion annually (9)

Estimated total costs of pediatric injury in the State of New York, accounting for medical care costs, lost future wages, and quality of life each year exceed $4 billion.

Costs of Asthma

Both direct and indirect economic costs are associated with childhood asthma. Indirect costs include missed school days (the disease is the leading cause of school absenteeism), lost work days by parents caring for children with asthma and lost productivity due to asthma-related premature deaths (7).

Costs of Birth defects

Costs associated with birth defects include not only medical care but also special education, lost productivity, and in many cases, decades of support services. Lifetime costs to care for an individual with a birth defect can be more than $800,000 (10).

In the United States, more than $8 billion is spent annually on medical treatments and supportive services for individuals with any of the 17 most common birth defects (11).

Costs of Neurodevelopmental Disabilities

Recent studies cited by the CDC have estimated that the lifetime cost to care for an individual with an Autism Spectrum Disorder is $3.2 million. Autism is the second most common developmental disability, after mental retardation (12).

Costs of Psychiatric Disorders

The costs of psychiatric disorders are great. In addition to medical and special education needs, these illnesses are contributing factors in failures in school and work, homelessness, and suicide. A study published in 2008 estimated the cost of lost earnings alone due to major mental disorders in the United States at around $193 billion a year (13)

Costs of Childhood Cancer

The costs related to pediatric cancer include direct medical care costs for each primary case of disease, as well as direct medical costs for secondary cases of cancer or other diseases that develop among patients sometimes years or decades after primary treatment. Indirect costs include lost parental wages, long-term lost wages due to reduced IQ from radiation treatments in pediatric brain cancer patients, and the loss of productivity resulting from premature death. The estimated annual cost of environmentally attributable childhood cancer is approximately $95 million nationwide.

Costs of Obesity

Over 12.5 million children are currently overweight or obese in the United States (13) For the nation as a whole, total obesity-attributable medical expenditures were estimated at $75 billion in 2003, with $17 billion financed by Medicare and $21 billion financed by Medicaid (14).

Costs of Injuries

Injuries account for approximately 15% of all health care costs from ages 1 to 19 in the United States. It has been estimated that pediatric injury accounts for more than $50 billion in annual losses from medical care costs, future wages, and quality of life (15).

Economic Benefits of Disease Prevention. Prevention of disease caused in children by toxic exposures in the environment has been documented to produce great economic benefits. For example, EPA's 1976 decision to remove lead from gasoline reduced environmental lead contamination across the country, lowered the average blood lead level of American children by 95%, increased the average IQ of all children born since 1980 by 4-5 points, and is estimated to have produced a net economic benefit for the United States of $200 billion each year since 1980, an aggregate economic benefit of over $6 trillion (16). The main driver of this economic benefit has been the increased economic productivity of the more intelligent workforce born since 1980.

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Recognition, treatment and prevention of environmentally related illness requires collaboration among a variety of health care providers including physicians, nurses, environmental specialists, industrial hygienists, social workers and health educators. Current available resources for prevention including public health interventions for children that promote treatment and education of environmentally mediated illness in New York State are fragmented and do not serve the whole state, nor are they tracked and reported.

A fundamental problem is that most physicians in New York are not trained to suspect the environment as a cause of disease. The four-year curriculum of the average American medical school devotes only seven hours of teaching time to topics in environmental health (1).

As a consequence of this lack of training, most physicians do not routinely obtain histories of environmental exposure from children and their families that would allow them to identify certain environmental exposures as the root cause for disease (2, 3).

There are relatively only a few clinical facilities where children can be seen for possible environmental exposures and evaluated for disease suspected to be of environmental origin. Thirteen Pediatric Environmental Health Specialty Units (PEHSUs) supported by the CDC exist nationwide. New York State has begun in the past decade to establish a statewide network of Centers of Excellence in Children's Environmental Health coordinated by the New York State Department of Health, but this network has faltered in recent years due to economic downturn (4).

The Pediatric Environmental Health Specialty Units (PEHSUs)

A national system of children's environmental health centers was established by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) in 1998. Consisting initially of two centers (Harvard University School of Medicine in Boston and the University of Washington School of Medicine in Seattle), this system of Pediatric Environmental Health Specialty Units (PEHSUs) now has expanded to a total of thirteen sites across the United States, Canada and Mexico. The PEHSUs serve as a resource for pediatricians, other health care providers, federal staff, and the public. They are designed to diagnose and treat children with diseases of toxic environmental origin, to reduce environmental health threats to children, to improve access to expertise in pediatric environmental medicine, and to strengthen health prevention capacity. Several of the PEHSUs have established training fellowships in environmental pediatrics, and they all provide education and training for healthcare practitioners (5, 6).

The Icahn School of Medicine PEHSU in Manhattan serves federal EPA Region II. It provides consultation, medical care and education for children and their families with toxic environmental exposures and with diseases of suspected environmental origin in New York, New Jersey, Puerto Rico and the Virgin Islands. Their service is also directed towards health care professionals, public health officials, and community organizations with concerns regarding children's environmental health (7).

Centers of Excellence in Children's Environmental Health

From 2006 to 2010, the New York State Department of Health oversaw a mandated statewide network of Centers of Excellence in Children's Environmental Health that has been established across New York by the State Legislature (4). New York is the only state in the US to have such a network. It was modeled on the national network of PEHSUs.

The purposes of these Centers of Excellence are to:

Increase the accuracy of diagnosis of children's diseases caused by environmental factors

Improve the treatment of children's diseases caused by environmental factors

Prevent diseases caused by environmental factors

Better quantify and describe the burden in the state of children's diseases of environmental origin

Strengthen and expand educational programs in children's environmental health for professionals at all levels

The funding history of the statewide network of Centers of Excellence in Children's Environmental Health is as follows:

'05-'06—$40,000 from Assemblyman Thomas DiNapoli to begin planning the Centers of Excellence in Children's Environmental Health

'06-'07—$200,000 from Assemblyman Thomas DiNapoli to initiate operations of the Centers of Excellence in Children's Environmental Health

'07-'08—$500,000 from Senator Marcellino to establish a Center of Excellence in Children's Environmental Health in Huntington, NY

SFY '08-'09—$800,000 from Assemblyman Sweeney for a statewide system of Centers of Excellence in Children's Environmental Health

Since 2010, funding for these Centers has faltered due to statewide economic factors (4).

Statewide Network of Occupational Medicine Centers

New York State's innovative Occupational Health Centers are recognized centers of excellence, providing a unique blend of diagnostic, prevention and support services for adult workers who suspect or have occupational injuries and illnesses. Created in 1987 by the New York State Legislature and funded from a surcharge on Workers' Compensation premiums, the clinics are coordinated by the Department of Health through contracts with sponsoring institutions. The clinics offer specialized medical diagnoses, high-quality care and support services for workers with occupational disease. They also meet the needs of businesses and workers by helping to identify and control workplace hazards and suggesting practical ways to reduce or prevent illness and injury.

All clinic directors are board-certified in Occupational Medicine. Treatment teams include nurses, industrial hygienists, social workers and occupational physicians. With seven regional centers and their satellite offices and one specially designated agricultural medicine clinic, occupational health services are available to workers across New York State. In addition, centers are establishing relationships with Workers' Compensation Preferred Provider Organizations resulting in enhanced co-ordination of health care services for injured workers. Each clinic accepts public and private medical insurance as well as Workers' Compensation. Clinics use a sliding fee scale and no worker is denied care because of a lack of resources. Clinics also track their client caseloads and report annually to the Department of Health (8).

These Centers have led the medical response to major disasters in New York State such as the terrorist attacks of September 11, 2001 and Hurricane Sandy in October, 2012.

Regional Lead Poisoning Prevention Resource Centers

Seven Regional Lead Poisoning Prevention Resource Centers are located strategically throughout New York State in teaching hospitals with pediatric services. The goal of the Regional Lead Poisoning Prevention Resource Centers is to improve the quality diagnosis and management of lead poisoning in New York State. These resource centers provide medical consultation and technical assistance to primary care providers within a geographic region on state-of-the-art management of lead poisoned children, and accept referrals of lead poisoned children for treatment. The Centers are located at: Albany Medical College; Children's and Women's Physicians of Westchester, LLP New York Medical College; Erie County Medical Center; Long Island Regional Poison Control Center at Winthrop University Hospital; Montefiore Medical Center; Pediatric Medical Services at State University of New York Health Science Center; and University of Rochester (9)

Statewide Network of Poison Control Centers

The New York State Poison Control Network Act established regional poison control centers in the state in 1986 (10).

The New York Poison Control Network comprises two regional poison control centers and is dedicated to preventing injury and death from poisoning by providing poison emergency assessment and treatment information, public education, and health professional education. The centers disseminate expert information to the general public as well as to professionals, participate in the collection of uniform data and conduct research to enhance the science of toxicology. Centers are located in Syracuse, and New York City (11).

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Chapter 9

New York State Department of Health Programs in Children's Environmental Health

The New York State Department of Health (NYSDOH) administers a series of programs designed to track and prevent various environmental health and safety hazards to children. These include:

Disease Tracking

New York is one of a series of states funded by the Centers for Disease Control and Prevention (CDC) to track disease of environmental origin through the Environmental Health Tracking Program (EHTP). This program extends traditional disease surveillance by jointly tracking environmental exposures and potentially related health outcomes. EHTP tracks drinking water contaminants, air pollutants and ozone levels, childhood blood lead levels, asthma hospitalizations, myocardial infarct hospitalizations, cancer, reproductive problems and cases of carbon monoxide poisoning. This information is tracked at the county level across New York State. Additionally, the New York State Department of Health has programs for tracking Fetal Alcohol Spectrum Disorders (FASD) and radon levels in homes across the state (1, 2).

Risk Assessments

For many years, NYSDOH has considered the special characteristics and unique vulnerabilities of children in developing risk assessments. In this work, NYSDOH uses standard risk assessment procedures, consistent with those used by the National Academy of Sciences and federal agencies such as the United States Environmental Protection Agency (US EPA), the United States Food and Drug Administration (US FDA), and the Agency for Toxic Substances and Disease Registry (ATSDR). Examples of approaches used by NYSDOH staff to consider the special characteristics of children in risk assessments include:

The use of methods and procedures described in US EPA documents (e.g., Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens) (3)

The use of child-specific uncertainty factors in deriving toxicity values such as reference concentrations (for inhalation exposures) and reference doses (for ingestion exposures)

The use of age-appropriate toxicity data

The use of child-specific exposure scenarios and exposure factors (e.g., such as those in EPA's Child-Specific Exposure Factors Handbook) (4)

Centers of Excellence in Children's Environmental Health

The New York State Department of Health oversees a legislatively mandated statewide network of Centers of Excellence in Children's Environmental Health that has been established across New York by the State Legislature. New York is the only state in the US to have such a network. It is modeled on the national network of Pediatric Environmental health Specialty Units (PEHSUs) supported across the US by CDC's Agency for Toxic Substances and Disease Registry (ATSDR). [It is described in detail in Chapter 8.]

These Centers of Excellence have proven to be outstandingly cost beneficial for New York State. The annual cost for the Centers is less than 0.01% of the costs of disease of environmental origin in New York's children. If these Centers can prevent as little as 1% of the environmentally triggered diseases in New York, then they will save $4.35 million annually, a return of nearly twenty-fold in decreased Medicaid expenditures and lost economic productivity. [See Chapter 7 for calculations.]

Lead Poisoning Prevention Program

New York State has a established an Advisory Council on Lead Poisoning Prevention that meets regularly to advise the New York State Department of Health and other State agencies on prevention of childhood lead poisoning. State Public Health Law gives power to the Commissioner of Health to enforce the correction of paint conditions that could lead to lead poisoning (5).

Statewide Network of Occupational Medicine Centers

Regional Lead Poisoning Prevention Resource Centers

Statewide Network of Poison Control Centers

These are described in Chapter 8.

Mercury Control Programs

In 2007, the New York State Department of Health (NYSDOH) has issued fish consumption advisories for 135 bodies of water across the State that have mercury contaminant levels for certain fish species higher than federal standards. The NYSDOH has indicated that women of childbearing age and children under the age of 15 should not eat any fish from these bodies of water (6).

Legislation signed into law in 2005, Chapter 603, prohibits the administration of vaccines having certain mercury levels to persons under the age of three years and to pregnant women. (7)

Mercury is used extensively in schools. The NYSDOH recommends that containers of elemental mercury identified by school staff or found during a school inventory be given the highest priority for removal. Should a spill occur, many individuals could be exposed, resulting in negative health effects, significant cleanup costs and widespread environmental contamination. Brochures are available on the New York State Health Department website about mercury exposure in schools geared toward parents, students, science teachers, buildings and grounds personnel, health and safety committees, superintendents, school boards, principals and school nurses as well as action steps to take if a spill occurs and phone numbers to contact in the case of an emergency (8).

Mold Control Programs

The New York State Toxic Mold Task Force, signed into law in 2005, chapter 356, created a task force to assess the nature, scope and magnitude of the adverse environmental and health impacts caused by toxic mold. The task force was not officially established until 2007; it published its report in Decemeber, 2010 (9). Recommendations include improvements to building codes, regulation mechanisms, research, education and outreach.

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NYS Department of Environmental Conservation Programs in Children's Environmental Health

The New York State Department of Environmental Conservation administers a series of programs designed to track and prevent various environmental health and safety hazards to children. These include:

Outdoor Air Pollution Control Program

New York State Environmental Conservation Law limits the idling time of trucks and busses, including school busses, to five minutes. Fines for the first violation range from $500 to $18,000 (1). New York City Law limits idling to three minutes, (one minute in locations adjacent to schools).

The New York State Environmental Board approved the implementation of the New York State Diesel Emission Reduction Act of 2006 (DERA) in June, 2009. Regulations under this Act dictate the retrofitting of old, dirty diesel engines with new Ultra Low Sulfur Diesel (ULSD) technologies. The regulations specify what engines are covered under the law and provide a timeline for installing the retrofit technologies. No less than 66% of all vehicles are required to have installed the retrofit technologies by December 31, 2009 and 100% of all vehicles are required to have installed the retrofit technologies by December 31, 2010 (2).

Mercury Task Force

The New York State Department of Environmental Conservation has established a Mercury Task Force to help coordinate its response to issues on mercury and the environment. These issues include: providing recommendations to the commissioner, addressing issues concerning regulating air emissions, remediating and preventing hazardous spills, assisting businesses in finding mercury-free alternatives, and monitoring water and habitat to keep toxic levels safe for fish, wildlife, and humans.

New York State Department of Environmental Conservation Law requires schools to identify and remove elemental mercury from school facilities.

Chapter 676 was signed into law in 2005 and prohibits the sale and distribution of certain additional mercury added products (3). Chapter 676 requires manufactures and trade associations dealing with mercury-added products to report certain information to the New York State Department of Environmental Conservation.

Chapter 611 of the laws of 2006 provides for the phase out of mercury added components in motor vehicles within five years (4).

New York State Department of Environmental Conservation's Final Regulations on the Management of Mercury and Dental Amalgam Wastes at Dental Facilities, effective May 12, 2006, prohibits the use of non-encapsulated elemental mercury in dental offices and requires dentists to recycle any elemental mercury or dental amalgam waste generated in their offices in accordance with regulations that the Department promulgates (5).

Pesticides

New York is one of only three states nationwide with pesticide registries; Massachusetts and California are the other two. In compliance with Article 33, Title 12 of the Environmental Conservation Law, the Pesticide Management Program of the Division of Solid and Hazardous Materials provides an annual report of pesticide sales and applications in New York State. Findings from the registry include:

> According to the 2005 Pesticide Reporting Law Annual Report (the most recent report available), pesticides are applied in most significant numbers in Suffolk, Westchester, Nassau, Erie and Monroe Counties (6). By contrast, in 1998, the county with the highest reported pesticide application was Kings County. (See figure Figure 4.5.) Pesticide use in New York has declined following widespread adoption of Integrated Pest Management (IPM) in public housing
>
> Well over 1,400 persons were reported to the New York State Pesticide Poisoning Registry in the ten-year period between 1998 and 2007. Of those reported, 20% were children. Typically, these cases occurred when pesticides were not stored or applied in appropriate ways (7)
>
> In 2005, commercial pesticide applicators in New York State applied 17,560,974 pounds (2,818,640 gallons) of chemical pesticides. This reflects an increase from the reported application in 2001 of 16,933,247 pounds (6)

Hazardous Waste Sites and Toxic Emissions

According to the EPA's Toxic Release Inventory, more than 17 million pounds of toxic chemicals were released into the air, water, and land in New York State in 2012 (8).

As of April 1, 1999, the Department of Environmental Conservation had identified 902 inactive hazardous waste sites in New York State that constituted significant threat to public health and the environment and were in need of remediation. Currently these are divided into 87 federal superfund sites and over 800 state superfund sites (9).

Volatile Organic Compounds (VOCs)

The Department of Environmental Conservation monitors ambient air quality, including VOC levels, throughout the state via the Toxics Monitoring Network. The purposes of this monitoring is to measure VOCs in industrial, residential, and rural settings; track changes in air quality in relation to VOC emissions; and to track industry in its efforts to reduce or control VOC emissions (10).

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NYS Department of of Education Programs in Children's Environmental Health

The New York State Department of Education administers a series of programs designed to track and prevent various environmental health and safety hazards to children. These include:

Indoor Air Quality

The Public Employees Safety and Health Act (PESH) protects teachers, administrators, and staff at public schools from certain toxicants in the air. Consequently, children are indirectly protected from poor air quality. However, there are no laws requiring schools to test indoor air quality, and there are no standards for indoor air established specifically for children.

Regulations of the Commissioner of Education, Part 155 (8 NYCRR 155) address several areas of indoor air quality in schools. Also known as the RESCUE (REbuild SChools to Uphold Education) regulations, they require schools to have an indoor air quality management plan, a preventive maintenance plan, and an IPM Plan; the regulations generally require schools to have a controlled supply of fresh air and have sufficient air changes to produce healthful conditions in order to avoid odors, build-up of concentrations of toxic substances, dust particles, and provide for specific protections to protect air quality during school construction and renovation projects. These regulations also require health and safety committees, and building inspections.

New York State RESCUE Regulations (REbuild SChools to Uphold Education) require abatement of lead paint in schools in accordance with federal protocols when such paint may be disturbed during renovation or construction projects.

Volatile Organic Compounds (VOCs)

Neither New York State nor the federal government has set standards for VOC levels in non-occupational settings, including schools, although guidelines are available.

Outdoor Air Pollution

New York State leads the nation in deaths and disease caused by diesel exhaust, according to the American Lung Association (1). To address this problem, the New York State Environmental Board approved the implementation of the New York State Diesel Emission Reduction Act of 2006 (DERA) in June, 2009. Regulations under this Act dictate the retrofitting of old, dirty diesel engines with new Ultra Low Sulfur Diesel (ULSD) technologies. The regulations specify what engines are covered under the law and provide a timeline for installing the retrofit technologies. No less than 66% of all vehicles are required to have installed the retrofit technologies by December 31, 2009 and 100% of all vehicles are required to have installed the retrofit technologies by December 31, 2010 (1).

[See Chapter 10 for more information.]

Pesticides

In August 2000, a New York State (NYS) law, Chapter 285, was enacted requiring prior notification of certain pesticide applications statewide at schools (grades K – 12) and licensed daycare centers. The law also includes provisions for requiring notification of certain commercial and residential lawn care pesticide applications, but only where local laws have been adopted (2). Under the law, licensed and registered day care centers in the state must provide at least 48 hours prior notice of pesticide applications at their facility. Notice must be posted in a common area, where it can be easily seen by people picking up and dropping off children (2).

Additionally, NYS Chapter 85 in December, 2010 created limits on pesticide use on playing fields and playgrounds at schools and day care centers (3).

Polychlorinated Biphenyls (PCBs)

For school buildings constructed or renovated between 1950 and 1977 and undergoing current renovation or demolition, New York State Education Department (NYSED) and New York State Department of Health (NYSDOH) recommend that the building(s) be evaluated prior to the renovation work to determine whether they contain caulk that is contaminated with PCBs. If contamination is found, an abatement plan is to be developed to address potential environmental and public health concerns (4). The New York City Board of Education has decided to accelerate the timeline for remediating PCB-containing light fixtures in public schools (5). A forthcoming new federal EPA has guideline on handling PCBs in school caulking will supersede this current recommendation from the department of Education.

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