Environmental Toxins and the Neurodevelopment of Infants and Toddlers

Impacts on Iowa Children

September 2011

This work was made possible by funding to Child Health Specialty Clinics (CHSC) from the Iowa Department of Education, American Recovery and Reinvestment Act (ARRA) Part C/IDEA/Early ACCESS federal funds.

Lead Authors: *Debra Waldron, MD, MPH, FAAP, Director and Chief Medical Officer, Child Health Specialty Clinics; Vice Chair for Child Health Policy and Statewide Health Services, Department of Pediatrics, University of Iowa Children's Hospital; and Ann Ricketts, MS, MPH, Consultant to Child Health Specialty Clinics*

EXECUTIVE SUMMARY

In September of 2009, the Early ACCESS Signatory Agency, Department of Education, charged the Child Health Specialty Clinics located at the University of Iowa to collect data and conduct an impact study of the effects of environmental toxins on the neurocognitive development of infants and toddlers. "These data are to be used to estimate the increased number of infants and toddlers who would be eligible for Early ACCESS (EA) services if selected environmental toxin exposure(s) were added to the list of EA eligible conditions and will be used for EA state level decision-making."

This report is based on a review of a database of over 325 articles, interviews with nine individuals, and analysis of reports and data produced by a number of state agencies and the University of Iowa. The focus of the report is on effects of toxins on neurodevelopment of children; other impacts such as cancer, respiratory problems, or obesity were not considered.

The Problem: The numbers of newborns and young children impacted by toxins are growing. Early ACCESS services are much too limited in capacity and funding to address the existing and increasing numbers of children who need developmental monitoring and in many cases intensive intervention services as a result of exposure to toxins. What is needed is a comprehensive, integrated and multi-systems approach. Some recommendations based on the work of many individuals and organizations in Iowa at the state and local level, and on potential cross-systems collaborations, are included at the end of the report.

". . . [V]irtually all research in toxicology and all environmental-health policy in the United States had prior to 1993 focused on the 'average 70-kg man' and took no cognizance of the unique exposures or the special susceptibilities of fetuses, infants, and children."[1]

Significant differences between children and adults contribute to children's increased susceptibility to pesticides and other toxic chemicals.

1. Children have greater exposure than adults to toxic chemicals on a body-weight basis
2. Children's metabolic pathways are immature
3. Children's incredibly rapid, but exquisitely delicate developmental processes are easily disrupted
4. Children have more time than adults to develop chronic diseases that may be triggered by harmful exposures in the environment[2]

It is only in the past 10-15 years that research on the impacts of various chemicals on the health of young children has been conducted.

[1] **Children's Health and the Environment: An Overview,** Philip J. Landrigan, MD, MSc, and Amir Miodovnik, MD, MPH *MOUNT SINAI JOURNAL OF MEDICINE* 78:1–10, 2011
[2] Ibid

Specific Toxins of Concern: A number of specific toxins exposures known to negatively affect children were researched and are highlighted in the following chart.

TOXIN	IMPACT ON NEURODEVELOPMENT	CHILDREN 0-3 YEARS IN IOWA EXPOSED/ AFFECTED	SOURCE OF EXPOSURE
Mercury	Mercury disrupts brain development by inhibiting important enzymes and preventing certain cells from dividing to produce more neurons and support cells. Research shows that mercury also increases the vulnerability of the brain to the adverse effects of other toxins at levels that are otherwise thought to be below dangerous thresholds, thereby producing a so-called "double hit."	2,300 to 6,400 Iowa children potentially exposed; 230 to 640 potentially affected.	*Coal fired plants, cement production facilities. Primarily larger fish*; population fishing for subsistence or food supply at particular risk.
Organophosphates	Higher in-utero organophosphate pesticide exposure was associated with increased odds of maternally reported pervasive developmental disorder at 24 months in one study and at 36 months in another. Additionally, researchers for the second study detected a negative association of exposure on attention problems with and without hyperactivity at 36 months. Findings from two studies focused on the development of older infants and children have suggested that in-utero exposure is associated with deficits in mental development and with maternal report of pervasive developmental disorder in children aged 2–3 years old. Children in the highest quintile of maternal DAP [particular pesticide] concentrations had an average deficit of 7.0 IQ points compared with those in the lowest quintile.	Potentially 20% or more of the 115,000+ infants born each year in Iowa are prenatally exposed. The number of these infants who will suffer long term negative effects is in the 100s or 1,000s – each year.	*Primarily agricultural pesticides/herbicides*. Exposure is higher in farm families for some specific substances, but not all. Iowa farm families using several different pesticides, have roughly four to six times higher concentrations than the geometric means in the U.S. representative subsample of National Health and Nutrition Examination Survey (NHANES), 1999- 2000.
Bisphenol A (BPA)	Behavioral abnormalities; also, birth defects, cancer, chromosomal and reproductive system abnormalities, cardiovascular system damage, early puberty and obesity are associated with BPA.	96% of Iowans may have detectable levels of BPA; levels higher among children, females, and lower income individuals. Number of children exposed and/or affected would at least be in the 100's if not 1,000's.	*Industrial sources or from product leaching, disposal, and use*. BPA is used to make products such as compact discs, automobile parts, baby bottles, plastic dinnerware, eyeglass lenses, toys, and impact-resistant safety equipment. Epoxy resins containing BPA are used in protective linings of some canned food containers, wine vat linings, epoxy resin-based paints, floorings, and some dental composites. About 5-6 billion pounds of bisphenol

			were produced annually worldwide.
Arsenic	Evidence that exposure to arsenic can cause cognitive delays.	Unknown	*Water sources such as private wells*. A 2006-08 statewide survey of 475 wells conducted by the University of Iowa and the State Hygienic Laboratory, showed that almost half of the water samples contained arsenic; about 8% of those had arsenic concentrations at or above 10 parts per billion, EPA's drinking water standard for public water supplies.
Illicit Drug Use	Cocaine, methamphetamine ("speed"), and methylphenidate (Ritalin) are psycho-stimulant substances that have been shown to cause functional impairments in animals and humans who experience prenatal exposure. Most prospective studies of prenatal cocaine exposure in humans report relatively modest developmental changes in infants and toddlers but measurable problems with attention, hyperactivity, and mood control as the children are followed into their early teen years.	According to an Iowa study, If appropriate hospital screening were done, 1,200 infants would be identified and referred each year.	*Maternal use of illicit drugs.* In one study, as a result of inadequate screening and testing, only 537 newborns were confirmed as having been exposed to drugs *in utero*. Very few of these 537 infants receive Early ACCESS services even though children exposed are eligible for these services, due in part to refusal by parents to these services when offered.
Prescription Drug Use during Pregnancy	FDA Category D drugs: "There is positive evidence of human fetal risk based on adverse reaction data from investigational or marketing experience or studies in humans, BUT the potential benefits from the use of the drug in pregnant women may be acceptable despite its potential risks." FDA Category X drugs: "Studies in animals or humans have demonstrated fetal abnormalities OR there is positive evidence of fetal risk based on adverse reaction reports from investigational or marketing experience, or both, AND the risk of the use of the drug in a pregnant woman clearly outweighs any possible benefit (for example, safer drugs or other forms of therapy are available)."	Based on national studies, between 4% and 9% of pregnant women use Category D and/or X prescription drugs. Thus approximately 1,500 to 3,000 infants are exposed each year (4,500 to 9,000 children 0-3y exposed in utero).	*In Utero exposure to FDA category D or X drugs*.
Lead	The primary functional deficits resulting from lead exposure, which have been demonstrated	Based on the high number of	*Lead paint and other household sources being*

	through repeated studies in both humans and animals, include a range of problems in learning and behavior problems, and decreased ability to focus and sustain attention.	children in Iowa with high blood lead levels, more than 1,000 children should be receiving EA services while only between 30-60 are.	*ingested by young children*. Approximately 7% of Iowa children are known to have lead levels above 10mcg/dl. Children with blood lead levels 20 mcg/dl are eligible for Early ACCESS services.
Tobacco Smoke	Effects on the child of prenatal tobacco exposure attributable to maternal tobacco use: 1. Poor growth.2. Behavioral and neurocognitive effects, including abnormal neonatal neurobehavior, developmental delay, attention deficit hyperactivity disorder, conduct disorder, other aggressive behaviors, and psychiatric disorders. 3. Speech processing difficulty. 4. Significant reductions in cortical gray matter and total parenchymal volumes and head circumference.	Over 5,000 newborns each year are exposed to tobacco smoke in utero. Between 500 and 775 each year are low birthweight and/or preterm.	*In utero exposure and second hand exposure to tobacco smoke.* 25.2% of pregnant women on Medicaid smoke; 48% of children in low income families are exposed to second hand smoke; 35% of children under 1 year of age live in households with adults who smoke.

Vulnerable Children Face Higher Risk: Most of the studies and articles regarding various environmental toxic exposures reviewed for this report reference the higher incidence of exposures and impacts on children who are lower income. "The impact of environmental toxicant exposure is exacerbated by other factors that contribute to susceptibility to disease such as race, ethnicity, and socioeconomic status. . . . Additional research on the cumulative impact of multiple risk factors that contribute to unequal negative health outcomes for vulnerable children is underway. In sum, there is substantial evidence that "environmental exposure is a contributor to higher incidence of disease and mortality experienced by certain racial/ethnic groups." Thus, program and policy work to make early childhood environments as healthy as possible is an important component of broader efforts to reduce disparities and help all children thrive. [3]

Interventions Can Positively Affect Outcomes: Interventions can make a difference in interrupting or ameliorating the negative impacts of environmental toxin assaults on children. While preventing negative environmental exposures is of paramount importance, early childhood interventions to improve developmental outcomes are really secondary prevention measures. "Although exposure to toxins can result in serious injury, the brain is also resilient as biology protects it over other organ systems and helps it resist the potentially negative impacts of outside threats. Moreover, when given the chance, the brain often demonstrates the

[3] **Environmental Health in Early Childhood Systems Building Opportunities for States***,* Andrea Bachrach, Louisa B. Higgins, Shannon Stagman, The National Center for Children in Poverty (NCCP), Columbia University, December 2010. http://www.nccp.org/publications/pdf/text_981.pdf)

capacity to recover from damage. This balance between vulnerability and resilience determines how different environmental conditions affect brain development over time." [4]

Key findings of a Rand Corporation study were:

- Early childhood intervention programs have been shown to yield benefits in academic achievement, behavior, educational progression and attainment, delinquency and crime, and labor market success.
- Interventions with better-trained caregivers and smaller child-to-staff ratios appear to offer more favorable results.
- Well-designed early childhood interventions have been found to generate a return to society ranging from $1.80 to $17.07 for each dollar spent on the program.[5]

Developing a Durable System of Care to Address Issues Facing Toxin Exposed Children: The research about interventions shows there is sufficient knowledge available now to address the challenges facing the realization of healthy child development. However, many barriers exist in the execution of what we know works. "Disjointed medical care in the crucial periods of preconception, pregnancy, and early childhood demands better coordination, as do a broad range of policies that affect families with young children who are facing significant adversities that threaten their physical and mental well-being. These policies include early care and education, child welfare, early intervention, workforce development, housing, urban planning, economic development, and environmental protection, among many others." [6]

A system of care is an organizational philosophy and framework that involves collaboration across agencies, families, and youth for the purpose of improving access and expanding the array of coordinated community-based, culturally and linguistically competent services and supports for children and youth with special healthcare needs and their families.

A "system of care" that ties together the many individuals, agencies and systems that touch the lives of children exposed to harmful toxins is necessary to realizing positive impacts for these children on a durable, ongoing basis.

Interventions for children exposed to harmful chemicals need to include: (1) preconception and prenatal education about and identification of exposures; (2) identification of exposed children and their referral by hospitals; (3) continuous developmental screening and monitoring of exposed children by public health, Early ACCESS, primary care providers, and/or social service providers; and (4) referral to more intensive interventions when delays are identified.

A methodology to move towards a system of care is outlined in the report.

---

[4] **EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

[5] **Proven Benefits of early childhood Interventions**, Rand Corporation: Objective Analysis. Effective Solutions, http://www.rand.org/pubs/research_briefs/RB9145/index1.html

[6] **The Foundations of Lifelong Health Are Built in Early Childhood**, co-authored by the National Scientific Council of the Developing Child and the National Forum on Early Childhood Programs and Policy, Harvard University's Center for the Developing Child,(http://developingchild.harvard.edu/resources/reports_and_working_papers/foundations-of-lifelong-health/

<u>Recommendations</u>

1. **The Early ACCESS (EA) Signatory Agencies would advocate for the establishment of a high level, cross-systems Children's Environmental Health Panel that would (a) educate on policies that limit toxin exposures for children, (b) plan and support the creation of bio-monitoring statewide for pregnant women and children, (c) coordinate efforts of all entities working in any way on prevention or intervention with young children and environmental toxin exposures, (d) identify funding sources to support systems of care for infants and young children and (e) maintain surveillance to identify the most harmful substances.**
2. **That the EA Signatory Agencies would recommend the implementation of the recommendations of the "Improving the System of Care for Iowa's Late Preterm Infants" and "The Health Practitioner's Role in Healthy Young Child Development" as they relate to developing systems of care and to addressing the social determinants of health. In addition, the Signatory Agencies would work to ensure that children exposed to harmful substances are referred for monitoring, assessment and/or intervention and that health care providers begin to do "environmental assessments," including screening for in utero drug exposure and early screening for lead and other toxins, and would limit prescribing C,D, or X medications for pregnant women.**
3. **That the EA signatory Agencies and the Bureau of Lead Poisoning Prevention work together to (a) ensure that all 0-3Y children with blood lead levels (BLL) of 20 mcg/dl or higher are referred to Early ACCESS, (b) that a new focus on encouraging the use of Early ACCESS services (monitoring and/or interventions) to families with young children with high BLL, and (c) develop strategies to increase the numbers of children at ages 1y and 2y who are tested.**
4. **That EA Signatory Agencies establish an advisory committee that would (1) identify the levels at which a child with mercury poisoning would be eligible for services, (2) promote at least pilot testing for mercury on blood samples for lead level testing, (3) utilize this committee to determine whether BPA and/or organophosphates should be included in Early ACCESS eligibility guidelines. (At this point in time, this would add very few children to Early ACCESS rolls because of limited testing.)**
5. **That the EA Signatory Agencies work with the Iowa Statewide Perinatal Care Program, the Child Protection Program at the University of Iowa, Iowa's birthing hospitals, and providers of prenatal care to advocate for adoption of screening protocols by birthing centers and prenatal care providers and to develop an effective system of referrals of infants who are assessed as drug (and alcohol) exposed at birth.**
6. **That the EA Signatory Agencies will consider recommendations for inclusion of children prenatally exposed to cigarette smoke as eligible for Early ACCESS services, or alternatively, that those children born low birthweight or late preterm AND exposed to tobacco smoke in utero be so included.**

Table of Contents

INTRODUCTION

In September of 2009, Early ACCESS Signatory Agency, Department of Education, charged the Child Health Specialty Clinics located at the University of Iowa to "collect data and conduct an impact study of the effects of environmental toxins on the neurocognitive development of infants and toddlers. These data are to be used to estimate the increased number of infants and toddlers who would be eligible for Early ACCESS (EA) services if selected environmental toxin exposure(s) were added to the list of EA eligible conditions and will be used for EA state level decision-making."

Further, the charge stated that state prevalence data on perinatal and early childhood toxin exposure and estimates of increased children eligible for EA services will be available by June 30, 2011 (extended to September, 2011).

REPORT OVERVIEW

This report is organized into sections on (1) the problem--an overview of environmental toxins and their impacts on infants and toddlers, (2) the impact of specific environmental toxins and drug use on infants and children from conception to age 3 years, (3) a history of the environmental toxin – lead – which is one of the eligible conditions for Early ACCESS services, (4) the impact of prenatal and childhood environmental exposure to tobacco smoke, (4) the vulnerability of low income children to toxin exposure, (5) interventions that can positively impact outcomes, (6) the need for a system of care for children affected by environmental toxins, and (7) conclusions and recommendations.

The methodology used for this report involved a review of a database of over 325 articles collected for this report. The author interviewed and corresponded with nine individuals at the State and the University of Iowa. Based on leads and suggestions from these interviewees, the author followed up on a number of other resources. The author also read reports produced by Iowa Department of Public Health and the University of Iowa and researched resources online. Following leads from one report or resource to another, the author attempted to identify activities of organizations working on these environmental toxin issues within the state. (For the list of persons interviewed see Attachment 1).

This report often uses articles and reports that are themselves compilations and summaries of multiple sources. Utilizing the Center for Disease Control and Prevention "Fourth National

Report on Human Exposure to Environmental Chemicals," this report attempts to make some rough estimates of the prevalence of certain chemicals in the population. However, these estimates should be taken for what they are – very approximate estimates.

What is clear to the authors is that the numbers of newborns and young children impacted by toxins are growing. Early ACCESS services are much too limited in capacity and funding to address the existing and increasing numbers of children who need developmental monitoring and in many cases intensive intervention services. What is needed is a comprehensive, integrated and multi-system approach. Some recommendations based on the work of many individuals and organizations in Iowa at the state and local level, and on potential cross-systems collaborations, are included at the end of the report.

THE PROBLEM

There are scores of environmental toxins where the evidence is clear, or at least very suggestive, that these toxins do significant harm to the health and development of young children. Some of these toxins affect children while they are still in utero, and others during early childhood. There is no doubt that young susceptible brains and bodies are much more sensitive and susceptible to harm.

The *Fourth National Report on Human Exposure to Environmental Chemicals* and the *Updated Tables, February 2011*, are published by the Center for Disease Control and Prevention (CDC). Since 1999, CDC has measured 219 chemicals in people's blood or urine. The *Fourth Report, 2009*, includes the findings from national samples for 1999-2000, 2001-2002, and 2003-2004. The Report also contains 75 new chemicals. [7]

Minnesota, Maine, and Washington have been required by their state's law to create lists of "chemicals of concern." In October 2010 Minnesota released its list, which contained over 1,700 different chemicals. A "chemical of high concern" means a chemical identified on the basis of credible scientific evidence by a state, federal, or international agency as being known or suspected with a high degree of probability to:

> (1) harm the normal development of a fetus or child or cause other developmental toxicity;
> (2) cause cancer, genetic damage, or reproductive harm;
> (3) disrupt the endocrine or hormone system;
> (4) damage the nervous system, immune system, or organs, or cause other systemic toxicity;

[7] **Fourth National Report on Human Exposure to Environmental Chemicals,** U.S. Department of Health and Human Services, Center for Disease Control and Prevention, 2009. http://www.cdc.gov/ExposureReport/pdf/FourthReport.pdf

(5) be persistent, bioaccumulative, and toxic; or
(6) be very persistent and very bioaccumulative

In sorting the list, the author found 91 chemicals where there was some evidence that they affected "development." [8]

According to a 2011 article in the *Mount Sinai Journal of Medicine* entitled "Children's Health and the Environment: An Overview," there are currently more than 80,000 chemicals registered for commercial use in the United States. Most are synthetics that have been invented in the last 50 years, most did not exist previously in nature, and many were initially hailed as beneficial and were presumed to have no negative effects. "But the widespread and, for the most part, uncritical introduction into commerce of thousands of new chemicals and chemical products such as asbestos insulation, leaded gasoline, organochlorine and organophosphate pesticides, polychlorinated biphenyls and the ozone-destroying chlofluorocarbons has created a series of new and unanticipated hazards for human health and the environment." Most of the new chemicals and compounds were not recognized as harmful until years or even decades later, after they had done widespread harm.[9]

Children are especially at risk of exposure to the 3,000 synthetic chemicals produced in quantities greater than one million pounds per year. These chemicals are widespread in the environment and can be found in common goods including cosmetics consumer goods, medications, motor fuels and building materials. A major problem is that only about half of these "high production volume" chemicals have undergone basic testing for potential toxicity, and 80 percent have not been tested for "their potential to cause developmental toxicity or to injure infants and children."[10]

The authors of this article on children's health and the environment state that this situation represents a grave lapse in stewardship by both the chemical industry and the federal government. "It creates a situation in which children are daily exposed to materials of unknown hazard, and it raises the very credible possibility that there are still undiscovered causes of disease and disability among the many chemicals to which children today are routinely exposed." The authors also suggest that these chemicals cause disease and disability through gene-environment interactions, and there exist vulnerable subsets of children.[11]

A policy paper by the National Scientific Council on the Developing Child states, "The absence of overt cognitive and behavioral deficits in infants and toddlers who have been exposed to

---

[8] Minnesota Department of Health: http://www.health.state.mn.us/divs/eh/hazardous/topics/toxfreekids/highconcern.html
[9] **Children's Health and the Environment: An Overview,** Philip J. Landrigan, MD, MSc, and Amir Miodovnik, MD, MPH *MOUNT SINAI JOURNAL OF MEDICINE* 78:1–10, 2011
[10] Ibid.
[11] Ibid.

neurotoxic substances often has a strong influence on establishing priorities for regulatory controls. However, long-term impacts of some early toxic exposures, which can include a so-called 'silent period' of normal functioning prior to the appearance of functional deficits, are not well understood. This typically results in public policies that fail to protect developing brains during pregnancy and early infancy." [12]

In the past twenty years, researchers have begun to recognize that children have unique vulnerabilities to toxic exposures in the environment. While parents and pediatricians long recognized the unique sensitivities of young children to environmental toxins, "virtually all research in toxicology and all environmental-health policy in the United States had prior to 1993 focused on the 'average 70-kg man' and took no cognizance of the unique exposures or the special susceptibilities of fetuses, infants, and children."[13]

The authors of the children's health and the environment article note that it was a 1993 report by the National Academy of Sciences (NAS), *Pesticides in the Diets of Infants and Children,* that changed the perceptions about children's vulnerabilities to chemicals in the environment. The principal recommendation of the report was that children require special protections against environmental hazards in law, regulation, and risk assessment that reflect their unique sensitivities. The major import of the NAS report was that for the first time ever it brought the issue of children's sensitivity to the attention of national policy-makers in the United States. This was a major shift in thinking.[14]

The NAS report identified 4 differences between children and adults that contribute to children's increased susceptibility to pesticides and other toxic chemicals.

1. Children have greater exposure than adults to toxic chemicals on a body-weight basis
2. Children's metabolic pathways are immature
3. Children's incredibly rapid, but exquisitely delicate developmental processes are easily disrupted
4. Children have more time than adults to develop chronic diseases that may be triggered by harmful exposures in the environment[15]

In the policy paper by the National Scientific Council on the Developing Child, the authors explained in a slightly different way the susceptibility of the brains of infants and children. The

[12] **EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

[13] **Children's Health and the Environment: An Overview,** Philip J. Landrigan, MD, MSc, and Amir Miodovnik, MD, MPH *MOUNT SINAI JOURNAL OF MEDICINE* 78:1–10, 2011

[14] Ibid

[15] Ibid

report noted that mature brains have a barrier of cells that restrict the entry of chemicals from the bloodstream into brain tissue, but that protective barrier is absent in the fetus and only reaches maturity in the first year after birth. "Thus, the time of greatest brain growth and most intensive construction of brain architecture is also the period that is most vulnerable to the relatively free passage of toxins into its cells. Similar to the impact of disrupting the construction of the foundation of a new house, early exposure to toxic substances has broader and more lasting effects on brain development than exposure later in life." [16]

While most of the infectious diseases that were the cause of compromised health and even death for young children are largely under control, the principal causes of sickness, disability, and death in American children today are chronic illnesses. Incidence and prevalence rates of the major chronic diseases of children are high, and for most are increasing. A part of this increase is due to some of the environmental exposures facing young children today.[17]

The National Center for Children in Poverty released a policy brief in December of 2010 entitled "Environmental Health in Early Childhood Systems Building." That brief stated that the body of research on child environmental health is already abundant and continues to grow. The brief then presents descriptions of some of the most researched harmful substances – specific air pollutants, endocrine disruptors, heavy metals and pesticides:

- Some of the most common sources of toxic exposure are household smoking; vehicular exhaust produced by diesel buses, other buses, cars and trucks; stationery sources such as factories, incinerators, power plants and dry cleaners. These sources are often located proximate to the places children live, go to school, or play. "Many pollutants transmitted through the air dispense polycyclic aromatic hydrocarbons (PAH) produced by the incomplete combustion of carbon compounds."
- An endocrine disruptor is a synthetic chemical that can mimic and block hormones and disrupt a body's normal function. These toxic disruptors are found in many plastic items including children's toys; baby bottles, cups and dishware; also in cosmetics and personal products; and food packaging materials and building materials. Bisphenol A (BPA) and phthalates are the two chemicals found to be of most concern. Phthalates are found in many cosmetics and personal products.
- Heavy metals such as mercury and lead are among the oldest known neurotoxicants. (The report notes that policy efforts to limit lead and mercury have been in effect for

[16] **EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

[17] **Children's Health and the Environment: An Overview,** Philip J. Landrigan, MD, MSc, and Amir Miodovnik, MD, MPH *MOUNT SINAI JOURNAL OF MEDICINE* 78:1–10, 2011

decades but limited energy has been focused on prevention at early childhood education venues and other strategic community locations.)

- Pesticides are some of the most threatening substances for children. In 2001, the EPA took action to limit exposure to the most dangerous pesticides by banning the residential use of chlorpyrifos and diazinon, but agricultural use of these pesticides is still permitted, and "*children in rural communities with parents employed in agricultural work face a particularly high risk of exposure*."[18]

According to the Children's Health and the Environment article, much research has been undertaken in only the past decade and has led to a number of important scientific discoveries about exposures that negatively affect the health and development of young children. They include:

- Recognition that prenatal exposure of baby boys to phthalates is associated with behavioral abnormalities at age 7–9 years that resemble attention-deficit hyperactivity disorder.
- Discovery that prenatal exposure to the organophosphate pesticide chlorpyrifos is linked to pervasive developmental disorder in children at age 4–5 years, according to maternal report.
- A report that prenatal exposure to the endocrine disrupting plastic chemical bisphenol A (BPA) is linked to behavioral abnormalities.
- Recognition that prenatal exposure to brominated flame retardants is linked to cognitive impairments in childhood.
- Discovery that prenatal exposures to the metals arsenic and manganese via maternal consumption during pregnancy of contaminated well water is associated with neurodevelopmental impairment in children.
- Discovery that prenatal exposure to polycyclic aromatic hydrocarbons is associated with deficits in infant cognition.[19]

The fact that there has been so much more research over the past ten to twenty years – including research into the impacts of lead and mercury which have been known to be neurotoxins for a century – is good news. Another positive is the emergence of environmental pediatrics or pediatric environmental health – "spurred by rising rates of chronic disease in children and rapid expansion in knowledge of the many connections, positive and negative, that exist between the environment and children's health." This branch of pediatrics "studies the

---

[18] **Environmental Health in Early Childhood Systems Building Opportunities for States,** Andrea Bachrach, Louisa B. Higgins, Shannon Stagman, *The National Center for Children in Poverty (NCCP)*, Columbia University, December 2010. (http://www.nccp.org/publications/pdf/text_981.pdf)

[19] **Children's Health and the Environment: An Overview,** Philip J. Landrigan, MD, MSc, and Amir Miodovnik, MD, MPH *MOUNT SINAI JOURNAL OF MEDICINE* 78:1–10, 2011

influence of the environment on health and disease in children and that diagnoses, treats, and prevents diseases and disabilities caused in children by environmental exposures." [20]

SPECIFIC TOXINS AFFECTING CHILDREN

Mercury

From the National Scientific Council on the Developing Child comes this quote:

> Mercury disrupts brain development by inhibiting important enzymes and preventing certain cells from dividing to produce more neurons and support cells. Research shows that mercury also increases the vulnerability of the brain to the adverse effects of other toxins at levels that are otherwise thought to be below dangerous thresholds, thereby producing a so-called "double hit." As for all neurotoxins, the degree to which developing brain architecture is disrupted by mercury ultimately depends upon the timing and level of exposure, each of which is influenced by the source of the toxin. Currently, emissions released by coal-fired power plants are the most important source of environmental mercury in the United States. This chemical is deposited into rivers, streams, and lakes where it is transformed by bacteria into a substance called methyl mercury, which is considered one of its most toxic forms. In recent years, the level of this dangerous chemical has been rising in the food chain, with the highest recordings found in contaminated fish (such as swordfish and tuna) as well as some shellfish, which are now the most significant sources of mercury exposure in the country and the most harmful to the developing fetus and young child. Direct exposure to other forms of mercury, through contaminated soil or air near industrial sites, is a relatively smaller contributor. Exposure to elemental mercury, through broken thermometers or switches, is also much less common and much less toxic than to methyl mercury."[21]

In a cohort study in Poland published in a U.S. Journal, mercury levels in cord and maternal blood at delivery were used to assess prenatal environmental exposure to mercury. Bayley Scales of Infant Development were used to assess neurobehavioral health outcomes. The cohort consisted of 233 infants who were born at 33 to 42 weeks of gestation between January 2001 and March 2003 to mothers attending ambulatory prenatal clinics in the first and second

[20] Ibid

[21] **EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

trimesters of pregnancy. Enrollment included only nonsmoking women with singleton pregnancies between the ages of 18 and 35 years who were free from chronic diseases.

> The geometric mean (GM) for maternal blood mercury level for the group of infants with normal neurocognitive performance was lower (GM = 0.52 µg/L; 95% confidence interval [CI], 0.46–0.58) than that observed in the group with delayed performance (GM = 0.75 µg/L; 95% CI, 0.59–0.94), and this difference was significant (*p* = 0.010). The GM of cord blood mercury level in the normal group also was lower (GM = 0.85 µg/L; 95% CI,0.78–0.93) than that observed in the group with delayed performance (GM = 1.05 µg/L; 95% CI, 0.87–1.27), and this difference was of borderline significance (*p* = 0.070). The relative risk (RR) for delayed performance increased more than threefold (RR = 3.58; 95% CI, 1.40–9.14) if cord blood mercury level was greater than 0.80 µg/L. Risk for delayed performance in the group of infants with greater maternal mercury levels (>0.50 µg/L) also was significantly greater (RR = 2.82; 95% CI, 1.17–6.79) compared with children whose mothers had mercury levels less than 0.50 µg/L. [22]

Children exposed in utero or at a very young age are the most likely to be affected by methylmercury, and fish consumption is the most likely route that this toxin is delivered. While Iowa fish are less likely to be contaminated with methylmercury than those from other areas of the country, some Iowa rivers and lakes do have methylmercury. The Iowa Department of Natural Resources, the United States Environmental Protection Agency Region VII (EPA), and the University of Iowa Hygienic Laboratory have cooperatively conducted annual statewide collections and analyses of fish for toxic contaminants; an effort known as the Regional Ambient Fish Tissue Monitoring Program (RAFT). The 2009 RAFT program in Iowa involved the collection of 54 samples from 31 water bodies, which is approximately one-third of lake sites and two-thirds of rivers. In the 2009 report, there were detectable levels of mercury in 18 sites; five of these sites had levels over 0.3 parts per million (ppm). [23]

The Iowa standard for a fish consumption advisory of no more than one meal of certain fish per week is currently at 0.3 parts per million. However, because mercury can accumulate in the body, the US Food and Drug Administration and the EPA “advise women who may become pregnant, pregnant women, nursing mothers, and young children to avoid some types of fish and eat fish and shellfish that are lower in mercury.” They also recommend that people check

---

[22] **Effects of Prenatal Exposure to Mercury on Cognitive and Psychomotor Function in One-Year-Old Infants: Epidemiologic Cohort Study in Poland,** Wieslaw Jedrychowski, PhD, Jeffery Jankowski, PhD, Elzieta Flak, MSc, Anita Skarupa, MSc, Elzbieta Mroz, MSc, Elzbieta Sochacka-Tatara,, MSc, Iwona Lisowska-Miszczyk, DrPH, et al. *Annals of Epidemiology*, Volume 16, Issue 6, Pages 439-447 (June 2006)

[23] **2009 REGIONAL AMBIENT FISH TISSUE MONITORING PROGRAM; SUMMARY OF THE IOWA ANALYSES,** Prepared by the Watershed Monitoring and Assessment Section, Iowa Geologic and Water Survey Bureau, Environmental Services Division, Iowa Department of Natural Resources, June 8, 2010 http://www.igsb.uiowa.edu/wqm/Biological/RAFT2009.pdf

local advisories about the safety of fish caught by family and friends in local lakes, rivers, and coastal areas, and if no advice is available, to only eat up to six ounces (one average meal) per week of fish caught from local waters, but not to consume any other fish during that week.[24]

According to the Iowa Environmental Council, a tougher standard than the 0.3 ppm has been debated in Iowa in the past. The Council also notes that "members of some ethnic and socioeconomic groups in the state practice subsistence fishing for cultural and economic reasons", and that several outdoor organizations encourage fishing for food as well as for sport. Those who rely on fish regularly may be exposed to unsafe levels of mercury. [25]

The Fourth National Report of blood levels of mercury shows that 10 percent of the sample of children ages 1-5 yrs had levels of 0.80 ug/L or higher. Levels rise with age, with over half of females having a level of 0.5 ug/L or greater. While these data cannot be translated directly into relative risk for developmental delays, they suggest that a very sizable proportion of newborns – perhaps as many as 10 percent – have a greater *relative risk* for delayed performance.[26]

In a clinical monograph about environmental impacts on reproductive health, the authors cite data from the National Health and Nutrition Examination Survey (NHANES) data, which show that both intake and blood mercury levels are highest in the Northeast region of the country and lowest in the Midwest. The geometric mean in the Northeast is 0.82-1.09 ug/L, while in the Midwest it is 0.58-0.74 ug/L.[27]

Without actual data from maternal and/or cord blood testing, determining the number of Iowa infants from birth to age three years who might be at risk due to high levels of methylmercury is a guessing game at this point. Looking at a range from two to five percent would mean that each year between 780 and 2,145 newborns would be at risk – or approximately 2,300 to 6,400 children ages 0-3.

In interviews with individuals at the University of Iowa and the State Hygenic Lab, it was noted that mercury could be tested with the same blood samples submitted for blood lead level testing.

---

[24] **http://www.fda.gov/food/resourcesforyou/consumers/ucm110591.htm**

[25] **MERCURY FROM COAL COMBUSTION: STILL A PROBLEM FOR IOWA'S AIR AND WATER QUALITY?**, *Iowa Environmental Council, Fact Sheet*. http://www.iaenvironment.org/documents/Mercury_Fact_Sheet_4-21-10.pdf

[26] **Fourth National Report on Human Exposure to Environmental Chemicals,** U.S. Department of Health and Human Services, Center for Disease Control and Prevention, 2009 http://www.cdc.gov/ExposureReport/pdf/FourthReport.pdf

[27] **Environmental Impacts on Reproductive Health**, ***Clinical-Proceedings***: an accredited clinical monograph from the Association of Reproductive Health Professionals, January 2010. http://www.arhp.org/publications-and-resources/clinical-proceedings/RHE/Introduction

Organophosphates

Again, from the National Scientific Council on the Developing Child is this description of the impact of organophosphates.

> Exposure to organophosphates (also called "OPs"), which are common ingredients in insecticides used widely in agricultural regions and by professionals for control of insect infestation in homes and commercial facilities, can cause mild to severe disruption of brain development. The most widely investigated of the organophosphates, chlorpyrifos (CPF), kills neurons, causes defects in neural cell migration, and reduces connections among brain cells. Other organophosphates also affect the production of neurons, supporting cells, and neurotransmitters. Thus, organophosphates disrupt a wide range of processes that are essential for the formation and function of brain circuits. Although animal research demonstrates that organophosphates produce microscopic changes that are difficult to detect, studies of functional outcomes in both animals and children demonstrate that modest changes in brain architecture caused by exposure to CPF can lead to measurable problems in learning, attention, and emotional control. [28]

In a 2008 study published in *Current Opinion in Pediatrics*, the authors summarized recent research on pesticide and child neurobehavioral development. In discussion of two studies – one done in the Salinas Valley among mostly Latino farm workers and a study in New York City – the authors note that though the results from the two cohorts differed somewhat in their conclusions related to mental and psychomotor development, both studies discovered an association between in-utero exposure to organophosphate pesticides and maternal report of pervasive developmental disorder. A quote from this 2008 review of studies reveals the growing evidence of the negative impact of organophosphates:

> Pervasive developmental disorder, which represents a constellation of behaviors consistent with Asperger's syndrome and autism- spectrum disorder, is one of many behavior problems that can be assessed using the Child Behavior Checklist. Higher in-utero organophosphate pesticide exposure was associated with increased odds of maternally reported pervasive developmental disorder at 24 months in the CHAMACOS cohort [Salinas] and at 36 months in the Columbia New York City cohort. Additionally, researchers from Columbia University detected a negative association of exposure on attention problems with and without hyperactivity at 36 months. At least two studies with similar exposure levels have observed an association of psychomotor deficits and in-utero exposure to DDE exposure. . . . In relation to in-utero exposure to

[28] ***EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing* Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

> organophosphates, both studies which examined neonates found a relation of abnormal reflexes and maternal organophosphate exposure. Findings from two studies which have focused on the development of older infants and children have suggested that in-utero exposure is associated with deficits in mental development and with maternal report of pervasive developmental disorder in children aged 2–3 years old. There are some inconsistencies across studies which may arise from differences in exposure and in the method of exposure assessment, but overall there is surprising consistency in the few studies that have been conducted. These studies suggest that there is reason to be cautious about exposure of pregnant women to DDT/DDE and organophosphates because of the potential effect on the neurodevelopment of their children. Policy-makers and pregnant women should be educated accordingly. [29]

In a study reported in the journal *Pediatrics*, the results were reported from research that compared various urinary OP concentrations for children diagnosed with ADHD and children not so diagnosed. One hundred nineteen children met the diagnostic criteria for ADHD. Children with higher urinary concentrations of various phosphates were more likely to be diagnosed as having ADHD. A 10-fold increase in the concentration of one phosphate was "associated with an odds ratio of 1.55 (95% confidence interval: 1.14 –2.10), with adjustment for gender, age, race/ethnicity, poverty/income ratio, fasting duration, and urinary creatinine concentration. For the most-commonly detected DMAP metabolite, dimethyl thiophosphate, children with levels higher than the median of detectable concentrations had twice the odds of ADHD (adjusted odds ratio: 1.93 [95% confidence interval: 1.23–3.02]), compared with children with undetectable levels."[30]

A 2008 review of epidemiological studies published in the *International Journal of Occupational Medicine and Environmental Health* summarized the results from 18 articles meeting the eligibility criteria (out of 120 identified). In the introduction, the authors note that recent studies have shown that the fetus and young child have lower than adult levels of detoxifying enzymes (paraoxonase or chlorpyrifos-oxonase) that deactivate OP, which implies that they may be more vulnerable to exposure. The hypothetic effects of perinatal exposure to pesticides include social and emotional deficits, autism, cerebral palsy and mental retardation. In addition, pesticide exposure may negatively influence the child's development while not producing any evident disease. However, compared to several studies on lead, mercury and

---

[29] **Pesticides and child neurodevelopment,** Lisa G. Rosas and Brenda Eskenazi, *Current Opinion in Pediatrics* 2008, 20:191–197 http://pesticidemededucation.com/pheep/html/images/stories/cases/case5/c5_rosas_symptoms.pdf

[30] **Attention-Deficit/Hyperactivity Disorder and Urinary Metabolites of Organophosphate Pesticides,** Maryse F. Bouchard, David C. Bellinger, Robert O. Wright and Marc G. Weisskopf, *Pediatrics*; originally published online May 17, 2010; http://pediatrics.aappublications.org/content/early/2010/05/17/peds.2009-3058

PCBs, few epidemiological studies have assessed the developmental neurotoxicity of pesticides.[31]

The following is a summary of the results of this 2008 review of studies:

> In all the studies, exposure to OP pesticides was associated with neurodevelopmental disorders reflected by a significantly worse score on right hand Finger Tapping and longer latencies on the Match-to-Sample test. Children exposed to methyl parathion and chlorpyrifos had more difficulties performing tasks that involved short-term memory and attention. An association was found between prenatal levels of OP metabolites and the problems in mental development and pervasive developmental disorders at 24 months of age as well as with increased reaction time and increased number of abnormal reflexes in newborns, and mental and emotional symptoms in adolescents. [32]

The most recent published study was in August of 2011 in *Environmental Health Perspectives*. This birth cohort study was conducted among predominantly Latino farm worker families in Salinas. (Another article about this birth cohort study is cited above.) The authors note that few studies have examined whether chronic exposure at lower levels could adversely affect children's cognitive development. This study examined associations between prenatal and postnatal exposure to OP pesticides and cognitive abilities in school-age children. Exposure to OP pesticides was assessed by measuring metabolites in urine collected during pregnancy and from children at 6 months and 1, 2, 3.5, and 5 years of age. The Wechsler Intelligence Scale for Children, 4th edition, was administered to 329 children 7 years of age. Analyses were adjusted for maternal education and intelligence, Home Observation for Measurement of the Environment score, and language of cognitive assessment. The results indicated that "[a]veraged maternal DAP concentrations were associated with poorer scores for Working Memory, Processing Speed, Verbal Comprehension, Perceptual Reasoning, and Full-Scale intelligence quotient (IQ). Children in the highest quintile of maternal DAP concentrations had an average deficit of 7.0 IQ points compared with those in the lowest quintile. However, children's urinary DAP concentrations were not consistently associated with cognitive scores."[33]

---

[31] **PRENATAL AND CHILDHOOD EXPOSURE TO PESTICIDES AND NEUROBEHAVIORAL DEVELOPMENT: REVIEW OF EPIDEMIOLOGICAL STUDIES,** Joanna Jurewicz and Wojciech Hanke*, International Journal of Occupational Medicine and Environmental Health* 2008;21(2):121 – 132 http://versita.metapress.com/content/g4470858487t28u4/fulltext.pdf

[32] Ibid.

[33] **Prenatal Exposure to Organophosphate Pesticides and IQ in 7-Year-Old Children,** Maryse F. Bouchard, Jonathan Chevrier, Kim G. Harley, Katherine Kogut, Michelle Vedar, Norma Calderon, Celina Trujillo,Caroline Johnson, Asa Bradman, Dana Boyd Barr, and Brenda Eskenazi1 *Environmental Health Perspectives*, Volume119, Number 8, August 2011 http://ehp03.niehs.nih.gov/article/info:doi/10.1289/ehp.1003185

In their conclusion, the authors noted that "prenatal but not postnatal urinary DAP concentrations were associated with poorer intellectual development in 7-year-old children." Also of note was the conclusion that the maternal urinary concentrations were higher but *nonetheless within the range of levels measured in the general U.S. population.*][34]

Exposure to organophosphates has been shown to be significantly higher in agricultural areas at least for some of the compounds. In a central Washington state study to determine children's exposure to organophosporus pesticides, it was found that median house dust concentrations of dimethyl OP pesticides in homes of agricultural families were seven times higher than those of reference families. Median pesticide metabolite concentrations in agricultural children were five times higher than those in reference children. Median pesticide concentrations in house dust and metabolite concentrations in urine from agricultural families were significantly higher in the children living near treated orchards (within 200 ft or 60 m) than those living more distant. "Ten of 61 agricultural children had detectable OP pesticide levels on their hands, whereas none of the reference children had detectable levels. These findings indicate that children living with parents who work with agricultural pesticides, or who live in proximity to pesticide-treated farmland, have higher exposures than do other children living in the same community."[35]

Iowa farm children are similarly exposed. A study done in the spring and summer of 2001, investigated potential pesticide exposure for 118 children of Iowa farm and non-farm households (66 farm, 52 non-farm). Each child provided an evening and morning urine sample at two visits spaced approximately one month apart, with the first sample collection taken within a few days after pesticide application.

> Estimated doses were calculated for atrazine, metolachlor, chlorpyrifos, and glyphosate from urinary metabolite concentrations derived from the spot urine samples and compared to EPA reference doses. For all pesticides except glyphosate, the doses from farm children were higher than doses from the non-farm children. The difference was statistically significant for atrazine ($p<0.0001$) but only marginally significant for chlorpyrifos and metolachlor ($p = 0.07$ and 0.1, respectively). Among farm children, geometric mean doses were higher for children on farms where a particular pesticide was applied compared to farms where that pesticide was not applied for all pesticides except glyphosate; results were significant for atrazine ($p = 0.030$) and metolachlor ($p = 0.042$), and marginally significant for chlorpyrifos ($p = 0.057$). The highest estimated

[34] Ibid.

[35] **Pesticide Exposure of Children in an Agricultural Community: Evidence of Household Proximity to Farmland and Take Home Exposure Pathways**, Chensheng Lu, Richard A. Fenske, Nancy J. Simcox, and David Kalman
Environmental Research Section A **84,** 290-302 (2000), available online at http://www.idealibrary.com

doses for atrazine, chlorpyrifos, metolachlor, and glyphosate were 0.085, 1.96, 3.16, and 0.34 microg/kg/day, respectively. None of the doses exceeded any of the EPA reference values for atrazine, metolachlor, and glyphosate; however, all of the doses for chlorpyrifos exceeded the EPA chronic population adjusted reference value. Doses were similar for male and female children. A trend of decreasing dose with increasing age was observed for chlorpyrifos.[36]

In a companion report on the same research, the results of pesticide exposure among the fathers and mothers were reported. Forty seven fathers and 48 mothers of the children reported in the other study participated in the study investigating take-home pesticide exposure.

> The adjusted geometric mean (GM) level of the urine metabolite of atrazine was significantly higher in fathers, mothers and children from farm households compared with those from non-farm households (P < or = 0.0001). Urine metabolites of chlorpyrifos were significantly higher in farm fathers (P = 0.02) and marginally higher in farm mothers (P = 0.05) when compared with non-farm fathers and mothers, but metolachlor and glyphosate levels were similar between the two groups. GM levels of the urinary metabolites for chlorpyrifos, metolachlor and glyphosate were not significantly different between farm children and non-farm children. Farm children had significantly higher urinary atrazine and chlorpyrifos levels (P = 0.03 and P = 0.03 respectively) when these pesticides were applied by their fathers prior to sample collection than those of farm children where these pesticides were not recently applied. Urinary metabolite concentration was positively associated with pesticide dust concentration in the homes for all pesticides except atrazine in farm mothers; however, the associations were generally not significant. There were generally good correlations for urinary metabolite levels among members of the same family.[37]

The Fourth Report in referencing the above study, noted that In Iowa farm families using several different pesticides, the geometric mean urinary levels were similar in parents and children, but levels were roughly four to six times higher than the geometric means in the U.S. representative subsample of the National Health and Nutrition Examination Survey (NHANES), 1999-2000. The Fourth Report also noted that in Minnesota and South Carolina, for "farmers who

[36] **Pesticide dose estimates for children of Iowa farmers and non-farmers,** Brian D. Curwin, Misty J. Hein, Wayne T. Sanderson, Cynthia Striley C, Dick Heederik, Hans Kromhout, Stephen J. Reynolds, and Michale C. Alavanji, *Environmental Research*. 2007 Nov;105(3):307-15. Epub 2007 Jul 19.

[37] **Urinary pesticide concentrations among children, mothers and fathers living in farm and non-farm households in Iowa,** Brian D. Curwin, Misty J. Hein, Wayne T. Sanderson, Cynthia Striley C, Dick Heederik, Hans Kromhout, Stephen J. Reynolds, and Michale C. Alavanji. *Annals of Occupational Hygiene*, Volume 51, No. 1:53-65, Jan. 2006. Epub 2006 Sep 19 http://annhyg.oxfordjournals.org/content/51/1/53.abstract

used chlorpyrifos, urinary levels averaged about six fold higher than those in the NHANES 1999-2000 subsample. Urinary levels of TCPy [metabolite of chlorpyrifos and chlorpyrifos-methyl] have been found to be hundreds fold higher for chlorpyrifos manufacturing and episodically many times higher for pesticide applicators than median levels from NHANES 1999-2000." [38]

Bisphenol A

As noted in earlier in this report, Bisphenol A (BPA) is synthetic chemical that can mimic and block hormones and disrupt a body's normal function. Also as noted, BPA has been found to be linked to behavioral abnormalities.

As reported in the Fourth National Report,

> Bisphenol A is a phenolic chemical which has been used for over 50 years in the manufacture of polycarbonate plastics and epoxy resins; in thermal paper production; and as a polymerization inhibitor in the formation of some polyvinyl chloride plastics. . . used to make products such as compact discs, automobile parts, baby bottles, plastic dinnerware, eyeglass lenses, toys, and impact-resistant safety equipment. Epoxy resins containing bisphenol A are used in protective linings of some canned food containers, wine vat linings, epoxy resin-based paints, floorings, and some dental composites. In recent years, about 5-6 billion pounds of bisphenol were produced annually worldwide. Bisphenol A may enter the environment from industrial sources or from product leaching, disposal, and use. In 1999-2000, bisphenol A was detected in 41.2% of 139 U.S. streams in 30 states. . ." [39]

A document on testimony before the Oregon House of Representatives given by Lisa Frack of the Environmental Working Group, a national organization with an office in Ames, was used for information on BPA for this report, as the document included a broad survey of research published in peer reviewed journals. The testimony "provided evidence that low dose chemical exposures can affect brain development *in utero*, in infants, and in children even when these exposures do not cause diagnosable disease." Frack noted that hundreds of peer-reviewed studies on exposures to BPA have linked it to a host of adverse health effects, including birth defects, cancer, chromosomal and reproductive system abnormalities, cardiovascular system damage, early puberty and obesity.

---

[38] **Fourth National Report on Human Exposure to Environmental Chemicals,** U.S. Department of Health and Human Services, Center for Disease Control and Prevention, 2009. http://www.cdc.gov/ExposureReport/pdf/FourthReport.pdf

[39] **Fourth National Report on Human Exposure to Environmental Chemicals**, U.S. Department of Health and Human Services, Center for Disease Control and Prevention, 2009 http://www.cdc.gov/ExposureReport/pdf/FourthReport.pdf

According to the testimony, the Centers for Disease Control and Prevention (CDC) have detected BPA in 93 percent of people six and older.

> Children ingest BPA through the food they eat and the beverages they drink, because sippy cups, baby bottles, infant formula and baby foods are contaminated with BPA, which leaches from the lining of metal food cans and/or lids. A 2007 investigation by EWG revealed that the leading makers of baby formula sold in the U.S. use bisphenol-A in the metal linings of canned liquid infant formula. A vast majority of these top companies also acknowledged its use in the packaging of powdered formula.
>
> The combination of widespread BPA contamination in liquid formula and its pervasiveness in biomonitoring studies clearly demonstrates the need to protect young children from exposure to food and beverage containers manufactured with BPA. . . .
>
> Furthermore, the society found that "even infinitesimally low levels of exposure – indeed, any level of exposure at all – may cause endocrine or reproductive abnormalities...particularly if exposure occurs during a critical development window. Surprisingly, low doses may even exert more potent effects that higher doses".[40]

Other Chemicals of Concern

In a scan of the Fourth Report, three other toxins were found where there is some evidence of their negative impacts on neurodevelopment, although their toxicity is often noted as carcinogenic: arsenic, Polybrominated diphenyl ethers (PBDEs), and Polychlorinated biphenyls (PCBs). Arsenic may be one toxin to continue to monitor, as there is recent research indicating that it can cause cognitive delays. Also, researchers at the University of Iowa are looking at arsenic – including the impacts of prenatal exposure. A 2006-08 statewide survey of 475 wells conducted by the University of Iowa's Center for Health Effects of Environmental Contamination (CHEEC) and the State Hygienic Laboratory, showed that almost half of the water samples contained arsenic; about 8% of those had arsenic concentrations at or above 10 parts per billion, EPA's drinking water standard for public water supplies. A new five year study funded by the Centers for Disease Control and Prevention (CDC) will measure arsenic levels in private residential wells. The State Hygienic Laboratory at the University of Iowa will provide

[40] **(Testimony Before the Energy, Environment and Water Committee Oregon House of Representatives On "SB 695 – BPA-Free Baby Bill"** of Lisa Frack, Environmental Working Group http://www.leg.state.or.us/committees/exhib2web/2011reg/HEEW/05-10-2011%20meetingmaterials/sb695frack5-10-11.pdf)

testing for the project that is being led by the Cerro Gordo County Department of Public Health.[41]

Illicit drug use

Illicit drug use by a woman during her pregnancy can have significant negative impacts on her newborn. The March of Dimes information on alcohol and drug use during pregnancy notes that many pregnant women who use illicit drugs also use alcohol and tobacco, making it very difficult to determine the impacts of specific drugs.[42] However, as the National Scientifc Council on the Developing Child notes:

. . [P]renatal exposure to Cocaine, methamphetamine ("speed"), and methylphenidate (Ritalin) are psycho-stimulant substances that have been shown to cause functional impairments in animals and humans who experience prenatal exposure. Unlike the adverse effects of alcohol and other neurotoxins that are noticeable in early childhood, the damage from prenatal psychostimulant exposure may not be apparent until later in life. Moreover, the specific impact of exposure to psychostimulants in humans has been relatively difficult to investigate, because pregnant women who abuse cocaine or other psychostimulants typically use alcohol and nicotine as well. Psychostimulants act by interfering with the regulation of a class of neurotransmitters (the monoamines) whose activation and inactivation are important for normal function in fetal brain development. Animal studies demonstrate that psychostimulants such as cocaine cause changes in the maturation of brain cells located in specific circuits that affect the ability to focus attention and regulate emotion. Most prospective studies of prenatal cocaine exposure in humans report relatively modest developmental changes in infants and toddlers but measurable problems with attention, hyperactivity, and mood control as the children are followed into their early teen years. [43]

Illicit drug use during an infant's prenatal period is included, along with alcohol, as an eligible condition for Early ACCESS services. However, it is unclear that there is a mechanism for referral for services – even if drug use during pregnancy is identified.

In an article in the Fall 2008 issue of the Early Periodic Screening, Diagnosis and Treatment (EPSDT) Program's Care for Kids Newsletter, Resmiye Oral, MD, Assistant Professor of Clinical Pediatrics and Director of Child Protection Program, University of Iowa Hospitals and Clinics, wrote that every year, Iowa welcomes an average of 38,000 newborns. "On the basis of known rates of drug use, we would expect 7-8 percent, or about 2,800 infants, to have been exposed

---

[41] **Cerro Gordo County study to measure arsenic in private wells,** Press release posted February 23, 2011 4:01 pm by University of Iowa News Services.

[42] http://www.marchofdimes.com/Pregnancy/alcohol_illicitdrug.html

[43] **EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

to drugs *in utero*. With an appropriate screening program, health care providers would identify about 1,200 of these newborns, and then refer them for evaluation and services."[44]

However, as Dr. Oral noted, as a result of inadequate screening and testing, only 537 newborns were confirmed as having been exposed to drugs *in utero*. Infants who have been exposed to drugs but who remain unidentified will be discharged to homes in which mothers are likely to continue to use drugs. Often these infants face continuing exposure to drugs and to the chaotic lifestyle and lack of nurturing often associated with drug use.[45]

In a 2006 article in the *Journal of Perinatology*, Dr. Oral reported on a study to determine the neonatal illicit drug screening practices of Iowa birthing hospitals. The study involved a cross-sectional survey design to investigate the impact of structured screening protocols on the numbers of neonates screened. Of 81 birthing hospitals, 53 (65%) participated in the study. Screening and positive test rates were higher in hospitals utilizing a structured screening protocol compared to those not utilizing one (10.9 versus 2.1% and 0.9 versus 0.2%, respectively, $P < 0.0001$). Hospitals with higher population, numbers of outpatients, inpatients, deliveries, and availability of drug abuse treatment services utilized a structured screening protocol more often.[46]

The article concluded that "utilization of a structured screening protocol increases the number of neonates screened for illicit drugs and positive testing rate regardless of urbanization. Regional standardization of structured screening protocols may improve the recognition of perinatal illicit drug exposure and provision of treatment services."

In the 2008 EPSDT Care for Kids article, Dr. Oral reported that the Perinatal Care Program Advisory Council of the Iowa Department of Public Health had approved a screening protocol, which was then included in the State Perinatal Care Clinical Guidelines. Members of the Perinatal Care Program staff are currently disseminating this protocol to birthing hospitals around the state. It calls for screening for perinatal drug exposure to be performed in the prenatal clinic, labor and delivery unit, and newborn nursery unit or NICU, and for services to be provided to both the mother and the newborn. [47] As of the writing of this report, it is unclear whether additional hospitals are screening for illicit drugs

The Federal Child Abuse Prevention and Treatment Act (CAPTA) of 2003 requires that substance-affected infants be referred to Child Protective Services, and further, that they

[44] http://iowaepsdt.org/EPSDTNews/2008/Fall08/PerinatalDrugExposure.htm
[45] Ibid.
[46] **Neonatal illicit drug screening practices in Iowa: the impact of utilization of a structured screening protocol**, Resmiye Oral, MD and T. Strang. *Journal of Perinatology*. 2006 Nov;26(11):660-6. Epub 2006 Oct 12 http://www.nature.com/jp/journal/v26/n11/pdf/7211601a.pdf
[47] http://iowaepsdt.org/EPSDTNews/2008/Fall08/PerinatalDrugExposure.htm

receive a developmental assessment under the Individuals with Disabilities Act (IDEA). According to a 2009 Federal report, there are few estimates of referral trends resulting from the new Federal policy. "Of the 10 States studied in depth, only two have strong links between IDEA referrals and CPS agencies. Because of the lack of uniformity in child welfare-referred developmental assessments used in most States, it is difficult to assess status in immediate postnatal services and the variability in State policy and practice is itself a finding." [48] [Iowa was not one of the ten states.]

It is not possible to ascertain how many of the referrals from hospitals or Department of Human Services agencies to Early ACCESS are for drug exposed children. However, what is reported from interviews is that very few of these referrals would come from hospitals; any referrals from hospitals regarding drug exposed infants are likely to be to human services agencies. Also based on interviews, few drug exposed infants are referred to and assessed by Early ACCESS through the human services route either. Parents of children who are drug exposed or who have been abused or neglected are offered the opportunity for assessment and services through Early ACCESS, but most do not follow through.

In 2009, there were 877 referrals to Early ACCESS from hospitals. This number would primarily include the hospital based high risk follow up program referrals – most of them premature infants. Also during 2009, Human Services referrals to Early ACCESS were 580, and most of these would be children entering into foster care and all CAPTA children. Few of the approximately 500-550 drug exposed infants would be among this number.[49]

Prescription Drug Use in Pregnancy

The United States Food and Drug Administration (FDA) has assigned five "pregnancy categories" to the drug formulary. These categories are assigned an "A," "B," "C," "D," or "X." The following is a chart from the FDA website showing the definitions of each category.[50]

Category	Definition
A	Adequate and well-controlled (AWC) studies in pregnant women have failed to demonstrate a risk to the fetus in the first trimester of pregnancy (and there is no evidence of a risk in later trimesters).

[48] **Substance-Exposed Infants: State Responses to the Problem**, Young, N. K., Gardner, S., Otero, C., Dennis, K., Chang, R., Earle, K., & Amatetti, S. *HHS Pub. No. (SMA) 09-4369*. Rockville, MD: Substance Abuse and Mental Health Services Administration, 2009

[49] ***ANNUAL PERFORMANCE REPORT*** *IDEA Part C FFY 2009 (2009-2010)*, Submitted February 1, 2011, State of Iowa Iowa, Department of Education, Bureau of Early Childhood Services, Grimes State Office Building, Des Moines, Iowa 50319-0146 http://educateiowa.gov/index.php?option=com_content&task=view&id=633&Itemid=597

[50] http://www.fda.gov/Drugs/DrugSafety/ucm245470.htm

B	Animal reproduction studies have failed to demonstrate a risk to the fetus and there are no AWC studies in humans, AND the benefits from the use of the drug in pregnant women may be acceptable despite its potential risks. OR animal studies have not been conducted and there are no AWC studies in humans.
C	Animal reproduction studies have shown an adverse effect on the fetus, there are no AWC studies in humans, AND the benefits from the use of the drug in pregnant women may be acceptable despite its potential risks. OR animal studies have not been conducted and there are no AWC in humans.
D	There is positive evidence of human fetal risk based on adverse reaction data from investigational or marketing experience or studies in humans, BUT the potential benefits from the use of the drug in pregnant women may be acceptable despite its potential risks (for example, if the drug is needed in a life-threatening situation or serious disease for which safer drugs cannot be used or are ineffective).
X	Studies in animals or humans have demonstrated fetal abnormalities OR there is positive evidence of fetal risk based on adverse reaction reports from investigational or marketing experience, or both, AND the risk of the use of the drug in a pregnant woman clearly outweighs any possible benefit (for example, safer drugs or other forms of therapy are available).

In a 2004 retrospective study of over 152,000 deliveries published in the Journal of Obstetrics and Gynecology, the authors determined that 64 percent of mothers were taking a prescription medication in the 270 days before delivery. Of concern was that 47.2 percent of the pregnant women in the study received prescription drugs from categories C, D, or X of the FDA pregnancy risk classification system; 4.8 percent from category D and 4.6 percent from category X. These findings highlighted the importance of understanding the effects of these medications on the developing fetus.[51]

In another study of medical record and survey data, the authors examined the use of prescription drugs and the use of Category D or X drugs. They determined that 56 percent of pregnant women used prescription drugs during their pregnancies and 4 percent of women were prescribed a category D or X drug. After adjustment for socio-demographic data, African American women were more likely to use prescription drugs than white women. "Lower levels of educational attainment, women with chronic health conditions, gestational diabetes, a prenatal hospitalization, a history of infertility, or symptoms of acid reflux were more likely to use prescription drugs." As with the other study, "the need for expanding the evidence about the risks and benefits of prescription drug use during pregnancy was concluded." [52]

---

[51] **Prescription Drug Use in Pregnancy**, SE Andrade, JH Gurwitz, RL Favis, KA Chan et al. *American Journal of Obstetrics and Gynecology*, 2004 Aug: 191(2): 398-407

[52] **Correlates of Prescription Drug Use During Pregnancy**, EH Riley, E. Fuentes-Afflick, RA Jackson, GJ Escobar, P Brawarsky, M. Schreiber, JS Hass. *Journal of Women's Health*, 2005 June; 14(5), 401-9)

The National Scientific Council on the Developing Child noted in its policy paper that a variety of prescription drugs that are safe for adults can cause serious damage to an immature nervous system.

> For example, both human and animal studies indicate that prenatal exposure to valproate, which is used to treat seizure disorders, can cause neural tube defects (i.e., defects in the spinal cord, such as spina bifida) and substantial disruption of early brain growth and architecture. Moreover, studies of postnatal exposure in animals demonstrate both destruction of brain cells and alteration in the formation of neural circuits involved in cognitive and behavioral functions. As expected from this type of developmental disruption, valproate, exposure during pregnancy can cause mental retardation, other cognitive deficits, and impaired emotional control.[53]

In Utero Exposure to Alcohol

For this report, the author did not do specific research into alcohol use and pregnancy, as the link between alcohol use by women during their pregnancies and serious developmental impacts on children is well established. The report by SAMSHA referenced in the above section on illicit drugs indicated that determining alcohol exposure in newborns is much more difficult than determining drug exposure. Thus, most children referred to Early ACCESS for services would be diagnosed FAS/FAE. It is important, however, to find ways to refer children *at risk* because of alcohol exposure, as opposed to already impaired.

LEAD EXPOSURES AND LEAD POISONING IN IOWA

Children with elevated blood lead levels over 20 micrograms per deciliter (mcg/dl) are eligible for Early ACCESS services regardless of whether or not there are any apparent developmental issues. Lead toxicity is truly in the category of conditions that have a "high probability of delays" if services were not provided, and is the only condition caused by a substance found in the environment that is one of the Early ACCESS eligible conditions. Thus, some history and background of lead and elevated blood lead levels may be helpful in consideration of inclusion of other toxins.

Lead was identified as a cause of significant health and developmental problems for young children in 1904 when children who had eaten paint chips in Queensland, Australia were

[53] **EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

poisoned. Since that time, hundreds of studies have shown without doubt that lead has a serious and long-term impact on children's health.

As the National Scientific Council on the Developing Child wrote:

> Lead can have adverse effects on several specific aspects of brain development. These include the formation and sculpting of neural circuits (i.e., the networks of connections among brain cells) as well as the process by which fatty tissue forms insulation around nerve fibers (known as myelination) like the insulation around the electrical wires in a house, which facilitates more rapid transmission of signals among brain cells. The disruptive effects of lead are due largely to interference with the normal function of several important neurotransmitters, including dopamine, glutamate, and acetylcholine. The primary functional deficits resulting from lead exposure, which have been demonstrated through repeated studies in both humans and animals, include a range of problems in learning, behavior, and the ability to focus and sustain attention.[54]

The American Academy of Pediatrics (AAP) produced a policy statement in 2005 on lead exposure in children. This statement reviewed 59 articles, and concluded that although lead levels have declined, approximately 25% of all children still live in housing with deteriorated lead-based paint and are at risk of lead exposure with resulting cognitive impairment and other sequelae. The policy statement also states that evidence continues to accrue that commonly encountered blood lead concentrations, even those less than 10 mcg/dL (micrograms per deciliter), may impair cognition, and there is no threshold yet identified for this effect. The statement continues:

> At the levels of lead exposure now seen in the United States, subclinical effects on the central nervous system (CNS) are the most common effects. The best-studied effect is cognitive impairment, measured by IQ tests. The strength of this association and its time course have been observed to be similar in multiple studies in several countries. In most countries, including the United States, blood lead concentrations peak at approximately two years of age and then decrease without intervention. Blood lead concentration is associated with lower IQ scores as IQ becomes testable reliably, which is at approximately 5 years of age. The strength of the association is similar from study to study; as blood lead concentrations increase by 10 mcg/dL, the IQ at 5 years of age and later decreases by 2 to 3 points. Canfield et al recently extended the relationship between blood lead concentration and IQ to blood lead concentrations less than 10 mcg/dL. They observed a decrease in IQ of more than 7 points over the first 10 mcg/dL

[54] **EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

of lifetime average blood lead concentration. Bellinger and Needleman subsequently reported a similarly steep slope in a reanalysis of data from their study of children with blood lead concentrations similar to those in the Canfield et al study. To confirm the adverse effects of lead on IQ at these concentrations, however, more children whose blood lead concentration has never been more than 10 mcg/dL should be studied. A reanalysis of the primary data from several of the prospective studies is underway to help resolve this issue. At the moment, however, these data have not yet been incorporated into policy, and the CDC and AAP both currently use 10 mcg/dL as the blood lead concentration of concern.

Other aspects of brain or nerve function, especially behavior, also are affected. Teachers reported that students with elevated tooth lead concentrations were more inattentive, hyperactive, disorganized, and less able to follow directions. Additional follow-up of some of those children showed higher rates of failure to graduate from high school, reading disabilities, and greater absenteeism in the final year of high school. Elevated bone lead concentrations are associated with increased attentional dysfunction, aggression, and delinquency. In children followed from infancy with blood lead measurements, self-reported delinquent behavior at 15 to 17 years of age increased with both prenatal and postnatal lead exposure, and bone lead, thought to represent cumulative dose, is higher in adjudicated delinquents. These data imply that the effects of lead exposure are long lasting and perhaps permanent. Subclinical effects on both hearing and balance may occur at commonly encountered blood lead concentrations. [55]

A 2008 article in *Current Opinion in Pediatrics* noted that adverse outcomes, such as reduced intelligence quotient and academic deficits, occur at levels below 10 mcg/dl.

Some studies suggest that the rate of decline in performance is greater at levels below 10 mcg/dl than above 10 mcg/dl, although a plausible mechanism has not been identified. Increased exposure is also associated with neuropsychiatric disorders such as attention deficit hyperactivity disorder and antisocial behavior. Functional imaging studies are beginning to provide insight into the neural substrate of lead's neurodevelopmental effects. Current protocols for chelation therapy appear ineffective in preventing such effects, although environmental enrichment might do so.[56]

[55] **Lead Exposure in Children: Prevention, Detection, and Management** – Policy Statement of the Committee on Environmental Health, American Academy of *Pediatrics*. *PEDIATRICS* Vol. 116 No. 4 October 2005 http://aappolicy.aappublications.org/cgi/reprint/pediatrics;116/4/1036.pdf)

[56] **Very low lead exposures and children's neurodevelopment,** David C. Bellinger, *Current Opinion in Pediatrics*. 2008 Apr;20(2):172-7

Iowa's Childhood Lead Poisoning Prevention program began in 1992, and is now part of the Bureau of Lead Poisoning Prevention within the Iowa Department of Public Health. Beginning in 1992, the Iowa Administrative Code required the results of blood lead testing done on Iowa residents to be reported to the Iowa Department of Public Health. IDPH has worked since 1992 to encourage providers to test all children for lead levels. Beginning July of 2008, Iowa law requires that all children be tested prior to entering kindergarten. Last year, approximately 98 percent of children were screened.

Iowa has one of the highest percentages of children with lead levels at 10 mcg/dl in the country – four times higher than most states. An estimated 13% of Iowa's children under age 6 years had elevated blood lead levels for the period 1992-1998. In the period between 2000 and 2005, data indicated that 9.4% of Iowa's children under age 6 had elevated levels.[57] Currently, the Iowa Bureau of Lead Poisoning Prevention states that approximately 7 percent of children under age 6 have elevated levels; that is, have blood lead levels (BLL) 10 mcg/dl or higher.

In 1994, a state advisory workgroup met to "develop recommendations to the Iowa Department of Public Health about linking Iowa's Lead Screening Program and Iowa's System of Early Intervention Services for infants and toddlers with disabilities." The workgroup consisted of representatives from the University of Iowa, the Child Health Specialty Clinics, the Iowa Academy of Family Physicians, the Iowa Osteopathic Medicine Association, the Iowa Chapter of the American Academy of Pediatrics, the IDPH Community Services Bureau, the IDPH Family Services Bureau, and the IDPH Iowa Lead Screening Program.

The workgroup determined the following rationale for linking the Iowa Lead Screening Program and Iowa's System of Early Intervention Services. First, they determined that the literature and clinic reports support the correlation between elevated blood lead levels and developmental delay or disability in children. Second, "although for any given child, experts cannot state that lead is the sole factor in causing development delays the correlation is strong enough to warrant referral for developmental evaluation and assessment of the development status of infants and toddlers with elevated blood lead levels."[58]

In 1992, the standards were that a BLL of 10 mcg/dl required follow-up services ranging from repeated blood lead testing to environmental interventions to inpatient chelation. Children with a venous blood lead level of 25 mcg/dl were referred for medical evaluation. "The Professional Advisory Workgroup determined that children with a venous blood lead level of 20

---

[57] **Healthy Iowans 2010 Mid-Course Revision**, July 2005. Distributed by the Iowa Department of Public Health, Lucas State Office Building, 321 E. 12th Street, Des Moines, Iowa 50319-0075, 515-281-5757 http://www.idph.state.ia.us

[58] **LINKING IOWA'S LEAD SCREENING PROGRAM AND IOWA'S SYSTEM OF EARLY INTERVENTION SERVICES (September 1994),** a file document provided by Rita Gergely, Bureau of Lead Poisoning Prevention, Division of Environmental Health, Iowa Department of Public Health, May 2011.

mcg/dl or higher should be referred to Iowa's system of Early Intervention Services for developmental evaluation and assessment. The Iowa Childhood Lead Poisoning Prevention Program will refer all children under age 3 years to the appropriate Area Education Agency for the child's residence."

The recommendation to refer children with elevated blood lead levels was implemented. However, instead of referrals to the Area Education Agency (AEA) in or near a child's residence, the referrals are going to agencies receiving Maternal and Child Health funding through the Iowa Department of Health. Thirty two agencies around the state ranging from local public health departments to visiting nurse associations to community action programs take these referrals.

Data on referrals were collected from the Bureau on Lead Level Poisoning and the Bureau of Family Health. The results are shown below on the following chart:

YEAR	Number Children 0-3 years with Lead Levels over 20 mcg/dL	Number children referred to MCH funded agencies	Number of children followed by Early ACCESS MCH funded agencies	Number received by and/or transferred to AEAs	Number of Children over 3 years w/Lead >20 mcg/dl	Number of refused or lost to follow up
2007-2008	108	56	30	6	4	16
2008-2009	83	56	28	5	2	22
2009-2010	98	67	16	4	7	40

Blood lead levels peak at one and two years of age. The Iowa requirement in statute that all children be screened prior to age six years or entrance to kindergarten means that many children are screened after age two or three years of age. Thus, the number of children screened at this most important time (<2 years of age) is much too low. The actual number of children served through Early ACCESS either through the MCH funded agencies or through the AEAs was a third of those referred who were tested with BLLs over 20 mcg/dL in 2007-2008 and declining to just 20 percent in 2009-2010.

Given the estimates that seven percent of children in Iowa have BLLs over 10 mcg/dl and assuming that as few as a third of these children have blood lead levels 20 mcg/dl or over, the number that should be receiving Early ACCESS services would be more like 2,700 rather than the 20 or 30 or 40 receiving services. Even if we looked at only two and three year old children and assumed that only 20 percent of the approximately 5,400 children with BLLs above 10 mcg/dl had the levels that would qualify them for Early ACCESS, over 1,000 children should be receiving services. Not all children with elevated blood lead levels will experience developmental or cognitive delays. However, all children should be monitored regularly. The Centers for Disease Control recommends the following: "Make long term developmental surveillance a component of the management plan for any child with a blood lead level (BLL) 20 mcg/dL, while recognizing that this will not necessarily result in referral for diagnostic assessment or intervention."

The Centers for Disease Control and Prevention (CDC) estimate that nationally, an estimated 83 percent of children with high blood lead levels are Medicaid eligible. Although concentrations have decreased in all children, African American children and children living in poverty continue to have higher blood lead concentrations. [59]

The Summary of Recommendations for Developmental Assessment and Interventions for lead poisoning from the CDC is as follows:

- Make long term developmental surveillance a component of the management plan for any child with a blood lead level (BLL) 20 mcg/dL, while recognizing that this will not necessarily result in referral for diagnostic assessment or intervention.
- Also consider developmental surveillance for a child who has a BLL that does not exceed 20 mcg/dL but who has other significant developmental risk factors.
- Do not base decisions regarding developmental assessment or intervention on a child's age at the time the child is found to have an elevated blood lead level (EBLL).
- If you wish to refer a child with an EBLL for intervention services, consider referring that child to early intervention/stimulation programs.
- Include a history of a child's EBLL in the problem list maintained in the child's medical record.
- Do not stop developmental surveillance when a child with an EBLL reaches age 6 or when the child's blood lead level is reduced. A responsible party (e.g., the child's PCP) should provide ongoing developmental surveillance of that child after the EBLL case is closed.
- In the developmental surveillance of children with EBLLs:
    - Watch for emerging difficulties at critical transition points in childhood: first, fourth, and sixth/seventh grades.
    - Watch for behaviors that interfere with learning, such as inattention and distractibility.
- Refer children experiencing neurodevelopmental problems for a thorough diagnostic evaluation.

- Be advocates for the child.[60]

---

[59] **Health Policy Statement: Lead Exposure in Children: Prevention Detection and Management**, American Academy of Pediatrics Committee on Environmental, *PEDIATRICS* Vol. 116 No. 4 October 2005, pp. 1036-1046 (doi:10.1542/peds.2005-1947 http://aappolicy.aappublications.org/cgi/reprint/pediatrics;116/4/1036.pdf

[60] **Managing Elevated Blood Lead Levels Among Young Children: Recommendations from the Advisory Committee on Childhood Lead Poisoning Prevention**. Centers for Disease Control and Prevention Atlanta: CDC; 2002. http://www.cdc.gov/nceh/lead/casemanagement/casemanage_main.htm

TOBACCO SMOKE – THE IMPACT ON THE NEURODEVELOPMENT OF INFANTS AND YOUNG CHILDREN

Tobacco smoke is the most common toxin affecting infants and children – in utero as well as via second hand smoke from adults. Both animal and human studies have documented cognitive impairments associated with fetal nicotine exposure, although according to the National Scientific Council on the Developing Child, these effects are significantly milder than those resulting from alcohol or other toxic chemicals. [61] However, smoking often is combined with other exposures which can significantly increase risks. For example, an analysis of the neurotoxic effects of prenatal environmental tobacco smoke combined with postpartum material hardship (unmet basic needs in areas of food, housing and clothing) showed depressed cognitive development (7.1 points) at a significant level ($p<.05$). [62]

Another study utilizing the National Health and Nutrition Examination Survey examined the contribution of prenatal tobacco smoke and environmental tobacco smoke to parent-reported learning disabilities. The study's conclusion was that exposure to tobacco smoke significantly increases the odds for children to have a learning disability. [63]

One document which collected 244 different studies on the adverse health events associated with prenatal smoking, prenatal exposure to second hand smoke and child exposure to second hand smoke is a Technical Report from the American Academy of Pediatrics. In Appendix 1 of the report, impacts on the fetus and on the child for various exposures were listed. Many of the impacts have to do with chronic health conditions such as asthma, other serious pulmonary or respiratory problems, diabetes, gastrointestinal disease, and cancers. The following highlights those impacts on development and cognition:[64]

Effects on the fetus of prenatal tobacco exposure attributable to maternal tobacco use:

- Growth abnormalities including: low birth rate and amplification of risk of low birth weight in fetus with cystic fibrosis and intrauterine growth retardation/small for gestational age.
- Delivery complications including premature rupture of the membranes, preterm delivery, and admission to NICUs.

[61] **EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

[62] **A Summary of recent findings on birth outcomes and developmental effects of prenatal ETS, PAH, and pesticide exposures**, FP Perera, V Rauh, RM Whyatt, D Tang, WY Tsai, JT Bernert, YH Tu et al from Columbia Center for Children's Environmental Health, Columbia University. *Neurotoxicology*. 2005 Aug;26(4): 573-87

[63] **Contribution of tobacco smoke exposure to learning disabilities**, L. Anderko, J. Braun, P. Auinger. *Journal of obstetric, gynecologic and neonatal nursing*: Jan 2010, 39(1): 111-117

[64] **Tobacco Use: A Pediatric Disease**, Committee on Environmental Health, Committee on Substance Abuse, Committee on Adolescence, and Committee on Native American Child Health, *Pediatrics* 2009; 124; 1474-1487. http://www.pediatrics.org/cgi/content/full/124/1474)

- Orofacial clefts (not clearly supported)
- Septal and right sided obstructive cardiac deficits

Effects on the child of prenatal tobacco exposure attributable to maternal tobacco use:

- Poor growth.
- Behavioral and neurocognitive effects, including abnormal neonatal neurobehavior, developmental delay, attention deficit hyperactivity disorder, conduct disorder, and other aggressive behaviors, and psychiatric disorders.
- Speech processing ability
- Significant reductions in cortical gray matter and total parenchymal volumes and head circumference.

Effects on the fetus and effects on the child of prenatal tobacco exposure attributable to maternal second hand smoke.

- Decreased birth weight
- Preterm delivery and spontaneous abortion
- Reduced cognitive development
- Conduct disorder

Risk of behavioral and neurocognitive effects are also attributable to a child's exposure to second hand smoke. [65]

In a prospective birth cohort study in two cities in Denmark, data on almost 6,000 children were analyzed for behavioral problems at ten years of age. The study found that compared with children not exposed to tobacco smoke, children exposed both pre- and postnatally to tobacco smoke had twice the estimated risk of being classified as abnormal according to the total difficulties score of the Strength and Difficulties Questionnaire. The cohort was children who were not premature or low birth weight. The results could not be explained by confounding variables of parental education, father's employment, child's time spent in front of computer or television screen, being a single father or mother, or maternal age. Almost 13 percent of the infants who were exposed pre- and post-natally were abnormal for hyperactivity/inattention at ten years of age, while 6.2 percent of those never exposed were abnormal. [66]

While smoking rates have been decreasing in Iowa over the past several years (current smokers now 18% compared with 23% in 2002), it is of concern that:

---

[65] Ibid.

[66] **Prenatal and Postnatal Tobacco Exposure and Behavioral Problems in 10-Year-Old Children: Results from the GINI-plus Prospective Birth Cohort Study**, Simon Ruckinger, Peter Rzehak, Chih-Mei Chen, Stefanie Sausenthaler et al. *Environmental Health Perspectives* 118(1), January 2010

- For young adults ages 18 -24, the percentage of smokers is 34%, almost twice the rate of older adults.
- Iowans who live in a household at or below the federal poverty level are 2½ times more likely to smoke than adults with higher incomes (44% vs. 17% respectively).
- Among current smokers, 48% had one or more children living in their household. [67]

Based on results from the 2005 Iowa Child and Family Household Health Survey, younger children and children in low income families are more likely to live in a household with someone who smokes. Thirty-five percent of children 0 through 1 year of age, and 48 percent of children whose families were below 134 percent of the Federal poverty level lived in households with someone who smokes.[68]

In Iowa, smoking by pregnant women on Medicaid is much higher than among women not on Medicaid; that is 25.2 percent of women on Medicaid smoked during their pregnancies compared with 6.5 percent of non-Medicaid women. This translates to almost 4,000 Medicaid covered infants born to mothers who smoked each year, compared to just over 1,500 non-Medicaid covered infants. Each year, approximately 360 babies would be born with low birth weights to Medicaid covered mothers, and about half that number to mothers not covered by Medicaid. Preterm births each year are 525 and 246 respectively.[69]

One of the items on the Iowa Certificate of Live Birth is on smoking before and during pregnancy. Data on the number of cigarettes or packs per day are collected for: three months before pregnancy, first three months of pregnancy, second three months of pregnancy, and third trimester. Unlike any other toxins, tobacco exposure during pregnancy is available – assuming that the respondents are telling the truth. Thus, identification for monitoring of these children is possible.

VULNERABLE CHILDREN FACE HIGHER RISK

Most of the studies and articles regarding various environmental toxic exposures reviewed for this report reference the higher incidence of exposures and impacts on children who are lower

[67] **2007 Iowa Health Fact Book**, University of Iowa College of Public Health and Iowa Department of Public Health. http://www.public-health.uiowa.edu/FACTBOOK

[68] **The 2005 Iowa Child and Family Household Health Survey. Early Childhood Results for children ages 0 to 5. Second report in a series**, Health Policy Research Program, Public Policy Center, University of Iowa; Iowa Department of Public Health; and Child Health Specialty Clinics, University of Iowa, February 2007. Published online at: http://ir.uiowa.edu/ppc_health/42

[69] **Births to Women on Medicaid: Iowa 2008 Smoking During Pregnancy,** Department of Public Health, Bureau of Family Health, 321 E. 12th Street, Des Moines, IA50309; 1-800-383-3826. http://www.idph.state.ia.us/apl/common/pdf/health_statistics/2009_medicaid_smoking.pdf

income. The following quote from the National Center for Children in Poverty clearly summarizes this observation:

> The impact of environmental toxicant exposure is exacerbated by other factors that contribute to susceptibility to disease such as race, ethnicity, and socioeconomic status. As a result, exposure risks and negative outcomes are particularly amplified for some children. The disparate effects of these factors of susceptibility take several forms. Socioeconomic disparities exacerbate the impact of environmental health exposure for the most vulnerable children who face higher levels of neighborhood environmental health hazards. Proximity to transportation and waste transfer facilities is an important factor in racial and economic environmental health disparities. This in part explains why minority and low-income children have disproportionately high asthma rates and asthma death rates. Low-income households have greater exposure to both heavy metals and endocrine disruptors transmitted through cleaning supplies, toys, and plastic houseware products sold at low cost "99 cent" retail establishments. In addition, low-income children often face higher levels of household exposure related to the occupational exposure of their parents, who are more likely to be employed in jobs with greater environmental health risks. Research suggests it is often the interplay of multiple psychosocial stressors (ranging from social and economic hardship to nutrition, genes, and preexisting health conditions) that causes negative outcomes. For example, a child with a nutritionally- challenged diet is likely to have more serious effects from lead exposure. Additional research on the cumulative impact of multiple risk factors that contribute to unequal negative health outcomes for vulnerable children is underway. In sum, there is substantial evidence that "environmental exposure is a contributor to higher incidence of disease and mortality experienced by certain racial/ethnic groups." Thus, program and policy work to make early childhood environments as healthy as possible is an important component of broader efforts to reduce disparities and help all children thrive. [70]

In the conclusions section of the 2005 Iowa Child and Family Household Health Survey for early childhood results, the authors state that although young children in Iowa are generally getting off to a healthy start in life, some children have factors putting them at risk for serious problems.

> For example, about one in six preschool children in Iowa are living below 100 percent of the FPL, placing them at risk for health and environmental problems as they grow and mature. Lower income children were least likely to have had health insurance coverage

[70] **Environmental Health in Early Childhood Systems Building Opportunities for States**, Andrea Bachrach, Louisa B. Higgins, Shannon Stagman, The National Center for Children in Poverty (NCCP), Columbia University, December 2010. http://www.nccp.org/publications/pdf/text_981.pdf)

> (even though they were likely to be eligible for Medicaid or ***hawk-I***), were more likely to have unmet need for medical and dental care. . .and were more likely to have been to an emergency room for care in the past year.[71]

INTERVENTIONS CAN POSITIVELY AFFECT OUTCOMES

Interventions can make a difference in interrupting or ameliorating the negative impacts of environmental toxin assaults on children. While preventing negative environmental exposures is of paramount importance, early childhood interventions to improve developmental outcomes are really secondary prevention measures. As the National Scientific Council on the Developing Child stated:

> Environmental influences can be positive or negative in very powerful ways, because they have the capacity to literally change the architecture of the brain as it grows. Although exposure to toxins can result in serious injury, the brain is also resilient as biology protects it over other organ systems and helps it resist the potentially negative impacts of outside threats. Moreover, when given the chance, the brain often demonstrates the capacity to recover from damage. This balance between vulnerability and resilience determines how different environmental conditions affect brain development over time. [72]

Another report developed for the Early ACCESS Council is "Improving the System of Care for Iowa's Late Preterm Infants." In that report, data on interventions that work for children at risk for developmental delays and disabilities were presented. While the focus of that report was on late preterm infants rather than environmental toxin exposed infants and young children, the interventions would be the same. Thus the narrative from that report is repeated here.

A Rand Corporation research brief published in 2005 was a study that synthesized what is known in the scientific research literature about the short and long-term benefits from early intervention programs. The Rand study focused on programs that provide child development services from the prenatal period until kindergarten entry and that had scientifically sound evaluations. Twenty such programs were identified, and fifteen were judged to have strong evidence base; four were too early in their measurement to be included as the children were not yet in kindergarten, though the evidence in these programs were designated "promising."

---

[71] **The 2005 Iowa Child and Family Household Health Survey. Early Childhood Results for children ages 0 to 5. Second report in a series**, Health Policy Research Program, Public Policy Center, University of Iowa; Iowa Department of Public Health; and Child Health Specialty Clinics, University of Iowa, February 2007. Published online at http://ir.uiowa.edu/ppc_health/42

[72] **EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

The nineteen programs which had strong or promising evidence base varied in approaches: some that concentrate on providing parent education and other family supports through home visiting or in other settings, early childhood education, and an approach that combines both.

Key findings of this study were:

- Early childhood intervention programs have been shown to yield benefits in academic achievement, behavior, educational progression and attainment, delinquency and crime, and labor market success.
- Interventions with better-trained caregivers and smaller child-to-staff ratios appear to offer more favorable results.
- Well-designed early childhood interventions have been found to generate a return to society ranging from $1.80 to $17.07 for each dollar spent on the program.

In the Rand research brief, it is also noted that the evidence indicates that there can be longer-lasting gains in outcomes such as special education placement and grade retention, high school graduation rates, labor market outcomes, social welfare program use, and crime.[73]

In March of 2006, an 18 year follow-up study of the Infant Health and Development Program (IHDP) was published in *Pediatrics* .[74] Robert Wood Johnson Foundation, one of the study funders, wrote on its website that the study *"…provides the best evidence to date of the sustained, positive effects of early educational intervention on children's long term outcomes."*[75] Additionally, improvements in cognitive and behavioral development were evident into adolescence. This study was a large, multi-site, randomized trial that was much larger than most previous research. The IHDP intervention served lower and higher-weight preterm infants. The original 36 month intervention consisted of home visits every week for the first year of the child's life and every other week in the second and third year, along with daily center-based education beginning at 12 months, and a support group for parents of participating children. The follow-up only (control) group received frequent pediatric assessments and community services when needed during the intervention period.

Assessments of the children in both groups were done at 3, 5 and 8 years of age and then at 18. "Positive long term benefits observed for the heavier low birth weight babies (2,001-2,499

---

[73] **Proven Benefits of early childhood Interventions**, Rand Corporation: Objective Analysis. Effective Solutions, http://www.rand.org/pubs/research_briefs/RB9145/index1.html

[74] "**Early intervention in low birth weight premature infants: results at 18 years of age for the Infant Health and Development Program,"** M.C. McCormick, J. Brooks-Gunn, SL Buka, J. Goldman et al, Pediatrics. 2006 Mar;117(3):771-80

[75] **Study Reveals Prolonged Effectiveness of Early Intervention Program**, Robert Wood Johnson Foundation, Publications and research, http://www.rwjf.org/pr/product.jsp?id=21796

grams) in the intervention group are highly comparable to normal birth weight babies. (There was a lack of observable benefits for the lighter low birth weight group).

In a review of the home visiting research literature, the research organization Mathematica assessed the evidence of effectiveness of home visiting models that serve families with pregnant women and children from birth the age five. This study was done under contract with the U.S. Department of Health and Human Services to determine which home visiting programs were evidence based. States must use at least 75 percent of the expanded funding for the Maternal, Infant, and Early Childhood Home Visiting Program under the Patient Protection and Affordable Care Act on an evidence based program. The researchers reviewed the evaluation literature and found eleven programs that fit their rigorous criteria and which were designed to improve outcomes in at least one of eight domains specified in the legislation: (1) child development and school readiness; (2) child health; (3) family economic self-sufficiency; (4) linkages and referrals; (5) maternal health; (6) positive parenting practices; (7) reductions in child maltreatment; and (8) reductions in juvenile delinquency, family violence, and crime. Seven of these eleven programs were found whose positive outcomes were based on clear evidence. All seven showed improvements in the domain of child development and school readiness. [76]

DEVELOPING A DURABLE SYSTEM OF CARE TO ADDRESS ISSUES FACING TOXIN EXPOSED CHILDREN

The research summarized above shows that there is sufficient knowledge available now to address the challenges facing the realization of healthy child development. However, many barriers exist in the execution of what we know works. "Disjointed medical care in the crucial periods of preconception, pregnancy, and early childhood demands better coordination, as do a broad range of policies that affect families with young children who are facing significant adversities that threaten their physical and mental well-being. These policies include early care and education, child welfare, early intervention, workforce development, housing, urban planning, economic development, and environmental protection, among many others." [77]

Interventions for children exposed to harmful chemicals need to include: (1) preconception and prenatal education about and identification of exposures, (2) identification of exposed

[76] ***LESSONS LEARNED FROM THE HOME VISITING EVIDENCE OF EFFECTIVENESS REVIEW,*** Submitted by Project Director: Diane Paulsell, Mathematica Policy Research, . Submitted to: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services, January 31, 2011. (http://homvee.acf.hhs.gov/)

[77] **The Foundations of Lifelong Health Are Built in Early Childhood**, co-authored by the National Scientific Council of the Developing Child and the National Forum on Early Childhood Programs and Policy, Harvard University's Center for the Developing Child,(http://developingchild.harvard.edu/resources/reports_and_working_papers/foundations-of-lifelong-health/

children and their referral by hospitals, (3) continuous developmental screening and monitoring of exposed children by public health, Early ACCESS, primary care providers, and/or social service providers, and (4) referral to more intensive interventions when delays are identified.

A “system of care” that ties together the many individuals, agencies and systems that touch the lives of children exposed to harmful toxins is key to realizing positive impacts for these children on a durable, ongoing basis.

Early ACCESS is limited by funding to serving a very small proportion of the children impacted by environmental toxins. Primary care providers for children, providers of prenatal care and birthing hospitals, home visiting programs (including the federally funded Maternal, Infant, and Early Childhood Home Visiting Program), early education programs (including the Department of Education’s “Positive Behavioral and Interventions Supports” program), screening programs, as well as Early ACCESS would need to work together to form a true “system of care.”

At the same time that this report on toxin exposures and children was commissioned, the ICEA and the Early Childhood Bureau of the Department of Education charged Child Health Specialty Clinics (CHSC) with two other projects. One charge is to develop a guide for innovation and excellence in addressing the social determinants of health. The other was to develop an improvement partnership focused on pediatric health care quality improvement efforts for Neonatal Intensive Care Unit (NICU) graduates/preterm infants. The emphasis of the project was to “build the infrastructure for a system of care for late preterm infants to ensure seamless, effective, efficient, family centered care including access to medical homes and integrated community-based services.” Both reports have relevance to the recommendations in this report, as many of the components of a system of care for late preterm infants or addressing the social determinants of health are the same as for toxin exposed infants and children.

The first report, done in collaboration with the Child and Family Policy Center is “The Health Practitioner’s Role in Healthy Young Child Development: Taking a Life Approach in Iowa.” This document -- or “notebook” -- provides the research, evidence and practice background for Iowa to take on the challenge of more intentionally and comprehensively developing an infrastructure to transform child health practice to one that recognizes and addresses social as well as medical determinants of health. In making the case for transforming child health care in Iowa, the authors state, “Young child healthy development is a function of biology, medical care – and social and physical environment.” They also write that:

- Health practitioners play an important role in encouraging healthy child development not only by addressing medical needs but also by screening for and initially responding to the non-medical factors harming healthy development.

- There is a strong interplay between social determinants of health and clinical health conditions, particularly around social, emotional, cognitive and behavioral development.

This notebook also describes the range of programs in Iowa that address social as well as medical determinants of healthy development – among them 1st Five, Project LAUNCH, Iowa's medical home initiative, EPSDT outreach workers, Part C and Early Childhood Iowa. While there are these and other exemplary programs in Iowa, there is no overall nexus or infrastructure for developing a cohesive "statewide system for expansion, innovation and continuous improvement of developmental health services that address social determinants." Opportunities for funding support to create this infrastructure are detailed. [78]

The second report, "Improving the System of Care for Iowa's Late Preterm Infants," details actions and recommendations to realize a system of care. Some of the descriptions that follow are taken from that report.

A system of care is an organizational philosophy and framework that involves collaboration across agencies, families, and youth for the purpose of improving access and expanding the array of coordinated community-based, culturally and linguistically competent services and supports for children and youth with special healthcare needs and their families.

A **system of care** incorporates a broad array of services and supports that is organized into a coordinated network, integrates care planning and management across multiple levels, is culturally and linguistically competent, and builds meaningful partnerships with families and youth at service delivery and policy levels. In a document, Building *a System of Care: A Primer*[79], the guiding principles of a system of care specify that services should:

- Be comprehensive, incorporating a broad array of services and supports
- Be individualized
- Be provided in the least restrictive, appropriate setting
- Coordinated both at the system and service delivery levels
- Involve families and youth as full partners
- Emphasize early identification and intervention

A Substance Abuse and Mental Health Services Administration (SAMHSA) short paper noted that providing "effective age-appropriate services and supports to young children and their

[78] **The Health Practitioner's Role in Healthy Young Child Development: Taking a Life Course Approach in Iowa**, CHSC and Child and Family Policy Center.

[79] ***Building Systems of Care: A Primer,*** Sheila A. Pires, *Human Service Collaborative, Washington, DC* Spring 2002. (for National Technical Assistance Center for Children's Mental Health, Center for Child Health and Mental Health Policy, Georgetown University Child Development Center and supported by Child, Adolescent and Family Branch, Center for Mental Health Services, Substance Abuse and Mental Health Services Administration, U.S. Department of Health and Human Services) http://gucchd.georgetown.edu/72382.html

families has immediate as well as long term benefits. Young children who receive effective age appropriate services and supports are more likely to complete high school have fewer contacts with law enforcement and improve their ability to live independently." The children that were the focus of the paper and who were receiving these services were those with social and emotional problems. According to this paper, an estimated nine to 14 percent of children from birth to age 5 years of age experience social and emotional problems that negatively impact their functioning and development. Even among babies, signs of depression can occur – inconsolable crying, slow growth and sleep problems.

While this paper did not look at the causes for these social and emotional problems in children, it would seem logical to conclude that at least some are caused by environmental toxins.

The "systems of care" discussed by the SAMHSA paper "facilitate coordination among each child's service providers, including preschools, schools, child protective services, primary care, and mental health providers." In addition "families partner with public and private organizations to develop individual service plans for their children that build on child and family strengths to establish effective services and supports."[80]

CONCLUSIONS AND RECOMMENDATIONS

It is hard not to feel a sense of urgency – if not alarm -- when reviewing the literature about exposure of very young children to so many toxins in their environments. Focusing on just one toxin – whether lead or tobacco smoke or illegal drugs or BPA or mercury – makes the problem seem manageable, although enormous. Looking at them all at the same time and realizing the multiplying impacts of exposures to more than one toxin -- can feel overwhelming.

The unequal burden that low income children face in terms of these exposures is another cause for alarm. While children from any economic background can and do have exposures to environmental toxins, it is much more likely that higher income children have fewer different exposures and are afforded supports and environments that can help ameliorate the negative impacts of such exposures. Low income children almost certainly have exposures to multiple toxins.

The good news when reviewing the literature is that progress has been made in decreasing the number of children with elevated blood lead levels and smoking rates are decreasing.

[80] **Addressing the Mental Health Needs of Young Children and Their Families: Systems of Care**, U.S. Department of Health and Human Services, SAMHSA, Center for Mental Health Services. HHS publication No. 10-4547, 2010. (www.samhsa.gov/children)

Prevention of toxin exposure is the first order of business. Clearly, this requires a mobilization of many individuals from many and diverse institutions and organizations to make headway. History has shown us that change is slow. Lead exposure is a case in point. It took from 1904 when lead was first identified as a serious toxin for children to 1978 when lead was removed from gasoline. Over the years, the proportion of blood lead levels in children has been declining primarily through efforts to address hazards in older homes, such as lead paint, and through extensive education programs. Still, more than a century later, from five to seven percent of children still have BLLs above 10 mcg/dl, and the funding necessary to eliminate lead paint exposures in homes is still very inadequate.

The much quoted National Scientific Council on the Developing Child makes the case well. Besides the moral imperative to do something about the preventable disability from environmental toxins, there are the real dollar costs to consider.

> The costs of cognitive impairments due to lead poisoning alone, for example, have been estimated to approach $43 billion per year, and the costs of mental retardation, autism, and cerebral palsy due to environmental pollutants have been estimated at $9 billion annually. The magnitude of this financial burden indicates that the prevention of brain damage by neurotoxic exposures should be assigned a higher priority for policies focused on public health, education, human capital development, and environmental protection. [81]

Efforts at prevention are critical. So too are efforts to be sure that children who are exposed to toxins, and who are likely to realize problems for all of their lives because of these exposures, receive the interventions that can reduce the negative impacts. This requires a coordinated system of care, which at present does not exist.

The remainder of this document will focus on recommendations to the ICEA. The first two of these recommendations are very broad focusing on systems approaches to prevention and for intervention. The final recommendations focus on the question of the current eligibility criteria for Early ACCESS services and which toxins might be considered for inclusion.

Recommendation 1:

The Early ACCESS (EA) Signatory Agencies would advocate for the establishment of a high level, cross-systems Children's Environmental Health Panel that would (a) educate on policies that limit toxin exposures for children, (b) plan and support the creation of bio-monitoring statewide for pregnant women and children, (c) coordinate efforts of all entities working in any way on prevention or intervention with young children and environmental toxin

[81] **EARLY EXPOSURE TO TOXIC SUBSTANCES DAMAGES BRAIN ARCHITECTURE**, National Scientific Council on the Developing Child, Center on the Developing Child. *Working Paper No. 4*,2006. http://www.developingchild.net/reports.shtml

exposures, (d) identify funding sources to support systems of care for infants and young children and (e) maintain surveillance to identify the most harmful substances.

Rationale

In the Lisa Frack testimony, she noted that biomonitoring studies have found up to 358 chemicals in cord blood from U.S. newborns. She notes that although the CDC calls biomonitoring "the most health-relevant assessment of exposure," it states that "[f]or children age 5 years and younger, minimal information exists on exposure to priority environmental chemicals, and [that] this lack of information is a major gap in protecting children from harmful exposures."

"Detection of a chemical in umbilical cord blood does not prove that it will cause harm. As researchers have mapped more and more of the 'human toxome,' however, scientists, public health experts and policymakers have embraced biomonitoring as the logical foundation for changing the way government regulates industrial chemicals. There is now widespread agreement that cord blood monitoring should be the starting point." [82]

Other than lead, exposure of Iowa children to dangerous chemicals cannot be ascertained. An ideal situation would be testing of all children at birth and/or during their most vulnerable years for those chemicals most harmful – and then for intervention to be provided to all those children with elevated levels.

A Policy Brief entitled "Environmental Health in Early Childhood Systems Building – Opportunities for States" was published at the end of 2010 by the National Center for Children in Poverty. In addition to the specific information on the impact of various toxins– some cited in this report—this policy paper advocates for the very important role that statewide environmental health initiatives can play in "broader early childhood systems-building efforts."

The Policy Brief suggests that strategic collaborations at the state level might include agencies responsible for health, child care and child welfare, education, housing, consumer protection and the environment. Some of the potential strategies to realize "cross-systems work" include:

- Some states have taken action to implement legal, regulatory and administrative restrictions on access to harmful substances. The Iowa statute requiring that all children be tested by age six is one example of such a statute.
- A few states have taken a cross-systems assessment approach to improve children's environmental health. Maryland developed a "Children's Environmental Health and

---

[82] **Testimony Before the Energy, Environment and Water Committee Oregon House of Representatives On "SB 695 – BPA-Free Baby Bill"** of Lisa Frack, Environmental Working Group http://www.leg.state.or.us/committees/exhib2web/2011reg/HEEW/05-10-2011%20meetingmaterials/sb695frack5-10-11.pdf

Protection Advisory Council" which reviews all relevant state regulations to see how well they serve to protect children's environmental health. The Council, which is composed of state policymakers and maternal and child health experts also collaborate on planning processes, grant applications and community education.

- A number of states have instituted policy changes that affect where children live, play or are cared for. Managing pesticides in buildings housing children – including public housing and day care centers – has been the focus of many state efforts. Providing resources to schools and day care centers that help them improve indoor air quality is another. Other efforts on preventing environmental health exposure risks in child care centers have incorporated environmental health training programs for child care workers and mandating testing for exposure risks as part of the licensing and certification process. A few states have programs that identify and reward child care centers taking active steps to reduce or prevent exposure. Oregon has developed extensive program resources that are available for use by other states interested in educating and empowering child care providers to reduce exposure to environmental toxins.
- "Initiatives involving providers seek to promote education and resource access through targeting maternal and child health practitioners, educators and administrators. Important strategies include integrating content on environmental health risks into physician licensing and continuing education, and instituting environmental health patient checklists." The Brief states that in recent years, there have been strong recommendations that routine environmental health risk assessment be included as part of standard medical care. States can play an important role in getting environmental health as a more integral part of standard medical training and ongoing education in hospitals and through continuing education.
- Public awareness is a critical component of any efforts to improve the environmental health for children. The goal of public awareness is to "connect information dissemination efforts to new audiences in order to reach families and children who may be at risk." In most states, including Iowa, environmental protection agencies have developed messages and materials for public education that are being underutilized and "would benefit from a creative new dissemination strategy driven by cross-agency collaboration."

Finally, the Brief recommends that states should consider research partnerships that might advance regional understanding of current health risks and potential benefits of various interventions. There are a number of important children's environmental health research efforts in Iowa, and strong linkages among these efforts and in partnership with policymakers and child health and child care providers would be key to quicker implementation of intervention efforts.

Three states that have enacted legislation relating to toxic chemicals in children's products are Maine, Washington and Minnesota. (There are a number of additional states who have banned BPA in baby bottles and sippy cups.) In May 2008, Maine enacted a statute requiring publication of a list of chemicals of high concern that was posted in July 2009, and designation of at least two priority chemicals, which may require safer alternatives from manufacturers. The 2008 Children's Safe Product Act required the Washington Department of Ecology along with the Washington Department of Health to identify and prioritize a list of high priority chemicals that children are likely to be exposed to, especially if present in children's products. Washington has named this list Chemicals of High Concern for Children (CHCCs). Washington's law requires companies to notify the state's Department of Ecology if CHCCs are present in children's products six months after rulemaking to implement the act is complete. Unlike Maine's law, Washington's legislation does not include a regulatory structure for banning the sale of products. To date, the Washington Department of Ecology has identified substances that meet the definition of high priority chemicals and identified those high priority chemicals that are of high concern for children (CHCCs) by considering children's potential for exposure to these chemicals. State agencies are working with the University of Washington to develop a mechanism to prioritize the list of CHCCs and identify the 50 chemicals they will focus on initially. Priority will primarily be based on exposure and toxicity.[83]

The Minnesota Toxic Free Kids Act became law in May 2009. The legislation required the Minnesota Department of Health (MDH), in consultation with the Minnesota Pollution Control Agency (MPCA), to create a list of Chemicals of High Concern based on hazard by July 1, 2010. It also required MDH to designate and publish a smaller list of Priority Chemicals by February 1, 2011, and required MPCA to prepare a report to the legislature by December 15, 2010, that includes the following:

- makes recommendations about mechanisms to reduce and phase out the use of Priority Chemicals in children's products, and promote the use of safer alternatives
- makes recommendations to promote consumer product design that uses green chemistry principles and that considers a product's impact over its life cycle
- discusses potential funding mechanisms to implement these measures
- report on stakeholder processes used to develop this report.[84]

[83] Toxic Free Kids Act: Interim Report to the Legislature, Minnesota Department of Health and Minnesota Pollution Control Agency, January 15, 2010. Available on line at http://www.health.state.mn.us/divs/eh/hazardous/topics/toxfreekids/interimreport.pdf

[84] http://www.pca.state.mn.us/index.php/component/option,com_docman/task,doc_view/gid,15319

One of the recommendations to states in the Policy Brief from the National Center for Children in Poverty is to find out what is already happening in the state and multi-state area.

> Investigate existing efforts to limit childhood exposure to environmental health risks and consider opportunities to advance strategic partnerships. State and local agencies that focus on the health and education of children, as well as those responsible for environmental protection and housing, may have initiatives under way that can be strengthened through expanded collaboration.[85]

The ICEA is represented by some of the agencies and institutions whose bureaus and departments would be part of a statewide partnership. The ICEA is also one of only two cross-agency entities that focuses exclusively on the health of young children. Bringing together individuals from throughout the state and representing many disciplines and perspectives could be instigated by the Council. The following is the list of those working in environmental health:

1. Over 70 individuals from throughout the state of Iowa were responsible for the development of sixteen specific recommendations on Environmental Health as part of Healthy Iowans 2010. The individuals were from state, local and federal agencies; various environmental and medical staff from the University of Iowa; Iowa State University researchers; and from environmental research and advocacy organizations.

   While most of the recommendations in the Healthy Iowans 2010 did not focus specifically on children, they covered agricultural chemicals in private wells, unintentional exposures to household hazardous chemicals, and protection from air pollutants. One key recommendation that did focus on children was reducing children's lead exposure. Among the report's recommendations was that all children should be screened – a recommendation that was realized by 2008. Another recommendation was "Reduce the health risks found in and around Iowa homes by taking a holistic approach and by successfully collaborating with other agencies, programs, and/or departments to unite efforts by the year 2005." Today there is a ***Healthy Homes Initiative*** within IDPH's Bureau of Environmental Health Services. A booklet entitled "Healthy Homes, Healthy People" is available in English and Spanish and covers many topics, including smoking, pesticides, household cleaners, water quality, lead exposures etc. While the team worked together for a limited time, its members worked effectively together and created an important action plan, and thus serves as a model of collaboration.

[85] **Environmental Health in Early Childhood Systems Building Opportunities for States,** Andrea Bachrach, Louisa B. Higgins, Shannon Stagman, *The National Center for Children in Poverty (NCCP)*, Columbia University, December 2010. (http://www.nccp.org/publications/pdf/text_981.pdf)

2. The Bureau of Lead Poisoning Prevention within IDPH already works with Early ACCESS, and is one of a very few programs focused on children. The Bureau also houses the Occupational Health and Safety Surveillance Program and the Pesticide Poisoning Surveillance Program. The Bureau is involved in overseeing remediation work, construction and renovation work, as well as in mandated lead level testing. IDPH is the recipient of a CDC grant, Healthy Homes and Lead Poisoning Prevention Program, with the Bureau and the Healthy Homes Initiative within Environmental Health Services Division as partners. The grant begins in September of 2011 and involves one year of planning. The project will involve a statewide advisory group.

3. Iowa is one of 23 states that have received funding through a US CDC grant to develop a state-based environmental tracking program that when combined will make up the national environmental public health tracking (EPHT) network. The CDC's national EPHT portal provides the cornerstone for the network. EPHT is the ongoing collection, integration, analysis, interpretation, and dissemination of data from environmental hazard monitoring, and from human exposure and health effects surveillance. The availability of these data in a standardized network portal will enable Iowan's to evaluate disease impact and trends, identify populations or geographic areas of impact, and to guide public health intervention and prevention policy efforts.

4. Polk County, Iowa is one of 43 sites nationwide that will be following children from the prenatal period through age 18. Impacts of genetics, environment, and services on the health and development of these children will be tracked prospectively. While this is a long term study that is just getting set up, over the next few years, any results or trends in outcomes will be available. The National Children's Study will examine the effects of the environment, as broadly defined to include factors such as air, water, diet, sound, family dynamics, community and cultural influences, and genetics on the growth, development, and health of children across the United States, following them from before birth until age 21 years. The goal of the study is to improve the health and well-being of children and contribute to understanding the role various factors have on health and disease. Findings from the study will be made available as the research progresses, making potential benefits known to the public as soon as possible.

5. At the University of Iowa, there is considerable work being done that impacts environmental health for children:
    - The University of Iowa's Center for Health Effects of Environmental Contamination (CHEEC) supports and conducts research to identify measure and prevent adverse health outcomes related to exposure to environmental toxins. CHEEC is conducting studies that relate directly to the focus of this report. For example, one study is

looking at exposures to drinking water containing nitrates or disinfection bi-products both at home and work among pregnant women. Current research includes such examples as "Exposure Assessment Method for Disinfection Byproducts in Drinking Water in the National Birth Defects Prevention Study," and "Nitrates, Nitrites and Nitrosatable Drugs and the Risk for Selected Birth Defects." The CHEEC Data Management Center is involved in a variety of epidemiologic studies of rural and urban populations in Iowa.

- The State Hygienic Laboratory and CHEEC have conducted a pilot project to identify heavy metals in cord blood – lead, cadmium and mercury. There were some "hits." The need to do biomonitoring in order to know about exposures and to understand dose to health impacts is a concern of the University researchers.
- The Great Plains Center for Agricultural Health is part of the University of Iowa College of Public Health. Its mission is "to help everyone contributing to the agricultural sector - farmers, workers, family members and their neighbors - through our research, outreach and education efforts which aim to detect and avoid hazards leading to illness and injury."

6. The Environmental Working Group (EWG) is a national organization, whose Midwest office is in Ames. The mission of the Environmental Working Group (EWG) is to use the power of public information to protect public health and the environment. The organization is a nonprofit, 501(c)(3) organization. In 2002, the EWG Action Fund, a 501(c)(4) organization was founded to advocate in Washington for health-protective and subsidy-shifting policies. The first goal of EWG is to protect the most vulnerable segments of the human population -- children, babies, and infants in the womb -- from health problems attributed to a wide array of toxic contaminants.

The list of those working in child development, child care and health would include:

- Early Childhood Iowa, an initiative to empower individuals and communities to achieve desired results to improve the quality of life for children ages birth-5 years and their families, has a Board comprised of citizens, legislators and representatives of the state agencies for Public Health, Human Services, Human Rights, Education, Economic Development and Workforce Development. The Early Iowa Council includes representatives from 50 public and private organizations, universities, parent organizations and more. One of the principles of Early Childhood Iowa is: To thrive, young children must have quality experiences, healthy and safe environments, and supportive people in their lives.
- Early childhood providers, researchers, state level leaders – Including Department of Education, Iowa State University, representation from the Statewide Leadership Team for the Program Wide Positive Behavioral and Interventions support.

- Primary care for pregnant women and children as represented by the Iowa Chapter of the American Academy of Pediatrics and the Society for Obstetrics and Gynecology and the University of Iowa.
- Birthing hospital representatives
- State and local public health, including the IDPH Bureau of Family Health and its MCH programs including home visiting.
- Representatives of child protection services at the state, local and University of Iowa level.

Recommendation 2:

That the Early ACCESS Signatory Agencies would recommend the implementation of the recommendations of the "Improving the System of Care for Iowa's Late Preterm Infants" and "The Health Practitioner's Role in Healthy Young Child Development" as they relate to developing systems of care and to addressing the social determinants of health. In addition, the Signatory Agencies would work to ensure that children exposed to harmful substances are referred for monitoring, assessment and/or intervention and that health care providers begin to do "environmental assessments," including screening for in utero drug exposure and early screening for lead and other toxins, and would limit prescribing C,D, or X medications for pregnant women.

The document "Improving the System of Care for Iowa's Late Preterm Infants," includes many recommendations that directly impact services for children impacted by toxins. The report describes a "system of care" for late preterm infants, which would be realized through a three year project. Many of the parts of this developing system of care would apply as well to toxin exposed infants and children. (In fact, prematurity is a common outcome for many kinds of exposures).

The system of care as described, begins with "Prevention." The first part of that system would be:

> *Education about the importance of NOT smoking during pregnancy* and avoiding second hand smoke should occur in a coordinated community and medical practice effort. Smoking cessation programs should be promoted both by physicians or nurse midwives and community organizations, and messages should be consistent and coordinated.

Other components of the system also have direct bearing on this project:

> Coordination between prenatal care providers, Early ACCESS and community based service providers is critical for women facing the stresses of poverty and/or mental health issues. Care coordination that is comprehensive and holistic that addresses nutrition, safety, housing, counseling, parenting supports etc. will improve outcomes for pregnant women.

Ongoing family-centered follow-up care in community-based settings is another component of the system with relevance to toxin exposed children**:**

(1) Optimal hand-off from the hospital to primary care providers.

(2) Home visitation for some infants

(3) Care coordination that focuses on all aspects of the child and family's lives, with families facing barriers of poverty or mental illness.

(4) Early, continuous screening and monitoring of late preterm infants provided by medical home, Early ACCESS, etc.

(5) Collaboration between primary care providers, community services/early intervention providers and families should be a "two-way" street where services are coordinated, easily accessible, and continuous. Care planning that is continually developed from a child's infancy through early childhood and beyond. Good communications between families and providers and among providers from different systems are the key to better outcomes.

One of the proposed recommendations in "Improving the System of Care for Iowa's Late Preterm Infants" is that a child health improvement project (Partnership to Improve Child Health in Iowa or PI CHI) be established and that its first project would be the creation of a system of care for preterm infants that encompasses prevention through long-term follow up. The system would incorporate a broad array of services and supports that are organized into a coordinated network. It would integrate care planning and management across multiple levels, be culturally and linguistically competent, and build meaningful partnerships with families and youth at service delivery and policy levels.

The goal of the project for "creating a system of care for late preterm infants and their families" would be realized through implementation of a three year project that would involve *two* learning collaboratives that would address all or some of the nine CMS recommended interventions for late preterm births. The second of the two learning collaboratives would bear directly on activities to create a system of care for toxin exposed infants and children to get monitoring and intervention services. Specifically, the second learning collaborative would focus on the follow up care of late preterm infants and would encompass the creation of a coordinated network between primary care practices, Early ACCESS, home visiting services, and community early childhood and child health organizations. Further, it would seek integrated services among the community organizations. Ongoing screening and monitoring of children and then seamless linkages to a continuum of community services are the desired outcomes. This "coordinated system" is key to a system of care for children with special needs.

One important piece of a system of care for children exposed to dangerous levels of environmental toxins is ongoing monitoring and assessments, especially developmental assessments. According to a Commonwealth Fund State Scorecard on Child Health System Performance for 2011, Iowa ranks very high on a number of measures. However, one that is very low is the percent of young children (ages 10 months-5 years) receiving standardized developmental screening during a medical visit. Only 18.7 children receive such a rating. At a minimum, all Medicaid children – or almost 40 percent of all children – should have regular developmental screening.

Recommendation 3:

That the EA Signatory Agencies and the Bureau of Lead Poisoning Prevention work together to (a) ensure that all 0-3Y children with blood lead levels (BLL) of 20 mcg/dl or higher are referred to Early ACCESS, (b) that a new focus on encouraging the use of Early ACCESS services (monitoring and/or interventions) to families with young children with high BLL, and (c) develop strategies to increase the numbers of children at ages 1y and 2y who are tested.

Rationale:

The negative impact of lead on a child's cognitive development has been well established, even at blood lead levels significantly below the 20 mcg/dl that automatically qualify a child for Early ACCESS. Iowa has a law requiring blood levels in children to be tested, and early intervention can significantly reduce long term problems. However, only about two thirds of children birth to 3 years of age are referred for Early ACCESS services, and less than two thirds of these children receive services. In fact for the year 2009-10, only 30 percent received services.

In addition, the data suggest that children are screened for lead exposure too late. The most vulnerable time for exposure is between one and two years of age. In the past three years, 108, 83, and 98 children respectively had blood lead levels at 20 mcg/dl. Given the high percentage of Iowa children with blood lead levels over 10 mcg/dl, one would expect many times more children to have elevated lead levels. Blood levels decline from a high between one and two years of age, and the opportunity for early identification and intervention may pass if lead testing is not done early.

The tools are in place to make much more of an impact on the problem of lead. A concerted effort to advocate for all children to be tested between ages one and two needs to be part of the plan. The report referenced earlier in this document, "The Health Practitioner's Role in Healthy Young Child Development: Taking a Life Course Approach in Iowa," is a guide to addressing the social determinants of health in young children. It proposes that child health practitioners are in a key position to serve at least as first responders to social determinants of health and further that there are both established guidelines for well child care as well as a growing array of exemplary programs that include "practitioner training and responses using developmental surveillance protocols that incorporate social determinants." Also the potential for Iowa to create an intentional infrastructure devoted to interactive assessment approaches that produce continuous learning and improvement – a center for pediatric innovation and excellence -- is also suggested in this report. These efforts at addressing proactively the healthy development of young children would certainly include early lead screening of children, as well as ongoing assessments, as part of developmental surveillance protocols.

The Bureau of Lead Poisoning Prevention and ICEA should identify where the gaps are between the numbers of children with high blood lead levels and the number of these children referred to Early ACCESS, and then institute changes. The gap between those referred and those receiving Early ACCESS services also needs to be addressed. Perhaps a new protocol for contacting families when their children have tested high needs to be developed or perhaps better educational and outreach materials need to be developed. Determining why families decline will be important for development or responses. The goal should be to have all children who are referred receive services.

Recommendation 4:

That Early ACCESS Signatory Agencies establish an advisory committee that would (1) identify the levels at which a child with mercury poisoning would be eligible for services, (2) promote at least pilot testing for mercury on blood samples for lead level testing, (3) utilize this committee to determine whether BPA and/or organophosphates should be included in Early ACCESS eligibility guidelines. (At this point in time, this would add very few children to Early ACCESS rolls because of limited testing.)

Rationale:

It is well established that methylmercury is a toxin that negatively impacts neurocognitive development. While the percentage of Iowa children affected may be much lower than in other parts of the country, there may be several hundred children affected, especially among populations who fish for their food and subsistence. Given that testing for mercury could be done at the same time as testing for lead, a pilot to determine whether methylmercury is a problem in Iowa might be done without a significant increase in costs.

The effects of BPA and organophosphates on neurocognitive development are more recently being studied, but the evidence is mounting that they seriously affect children. Given that Iowa is a rural state and that levels of some of the organophosphates in children are higher than the national average, a way to identify and then provide early intervention services for these children is critical. Organophosphates need to be a focus for identification and intervention.

Recommendation 5:

That the Early ACCESS Signatory Agencies work with the Iowa Statewide Perinatal Care Program, the Child Protection Program at the University of Iowa, Iowa's birthing hospitals, and providers of prenatal care to advocate for adoption of screening protocols by birthing centers and prenatal care providers and to develop an effective system of referrals of infants who are assessed as drug (and alcohol) exposed at birth.

Rationale:

It is difficult to determine with any certainty the actual numbers of children exposed to illicit drugs, non-prescribed medications or alcohol. A National Survey on Drug Abuse and Health by the Substance Abuse and Mental Health Services Administration (SAMHSA) in 2005-2006 found that "4 percent of pregnant women reported using illicit drugs in a given month compared to 10 percent of non-pregnant women. In addition, an estimated 11.8% of pregnant women reported current alcohol use, 2.9% reported binge drinking, and 0.7% reported heavy drinking based on 2005-2006 combined data."[86]

In Iowa, alcohol is the most frequently used substance with 53 percent of residents 12 and over who are current users (2006 data). According to the Iowa Substance Use Epidemiological Profile, the rates of current alcohol use and binge drinking by Iowa adults are significantly higher than the corresponding national rates, while illicit drug use in Iowa appears to be holding steady at a level lower than the national prevalence. In this 2009 epidemiological profile, information on alcohol use by pregnant women was not presented as these data are no longer collected due to questions regarding accuracy. [87] Data on illicit drug use were not presented either. In the 2002 *State Treatment Needs Assessment Program for Adult Substance Use*, the results from the approximately six percent of women who were pregnant at the time of the interview or during the 12 months prior, were that 6.4 percent indicated that they had used any alcohol during pregnancy, and 0.9 percent reported using illicit drugs or medications not prescribed for them or over the counter medications not used as indicated.[88]

As noted in the section on illicit drugs, Dr. Oral cited estimates of between seven and eight percent of known drug use during pregnancy. Thus, the percentage of births where the mother is exposed to illicit drugs or medications not prescribed is somewhere between about 2 percent

---

[86] **PRENATAL SUBSTANCE EXPOSURE APRIL 2008,** National Abandoned Infants Assistance Resource Center , UC Berkeley, http://aia.berkeley.edu/media/pdf/2008_perinatal_se.pdf

[87] **State of Iowa Substance Use Epidemiological Profile, Iowa Epidemiological Outcome Workgroup, February 2009** http://iconsortium.subst-abuse.uiowa.edu/downloads/IDPH/sub_abuse_epi_2009.pdf

[88] **Iowa 2002 STNAP: State Treatment Needs Assessment Program For Adult Substance Use**, Center for Social and Behavioral Research, University of Northern Iowa for Iowa Department of Public Health, Division of Behavioral Health and Professional Licensure and Cener for Substance Abuse Treatment, Substance Abuse and Mental Health Services Administration, October 2004, OMB No. 0930-0238. http://www.idph.state.ia.us/bh/common/pdf/substance_abuse/state_treatment_needs_2002.pdf

and 8 percent -- or between approximately 790 and 3,100 infants each year. The numbers of alcohol exposed would be more than double those numbers.

Whatever the numbers of exposed infants in Iowa, it is critical that each one receive immediate services. A factsheet out of the University of California at Berkeley, cites research which suggests that female substance users have socioeconomic, emotional, and psychological disadvantages when compared to non-using women, which in turn can affect children's growth and development. Poverty and unemployment have both been associated with substance abuse, and mental illness and histories of emotional, physical, and sexual abuse are common among female substance abusers. "Literature suggests that these social and psychological problems common to women substance abusers also impact the child's development after birth."

As noted in this report, much work has been done in Iowa on developing a protocol on perinatal illicit drug screening and intervention within the Child Protection Program at the University of Iowa Children's Hospital. As stated in a document on the Program's website, "The sole goal of identification is to provide early access to assessment and treatment for the mother/infant dyads without application of punitive measures." Intervention has been shown to make a difference.

As stated in the Child Protection Program document, the steps to realizing identification and intervention around substance exposed children are:

- Develop a community practice guideline for perinatal illicit substance use screening and testing
- Identify illicit substance using patients during pregnancy and their exposed infants
- Provide a screening tool to identify the patients and infants at risk for use and exposure
- Provide guidelines for referral and intervention both for the mother and the infant
- Increase secondary and tertiary prevention efforts to reduce pregnancy related illicit drug use/abuse[89]

Recommendation 6:

That the Early ACCESS Signatory Agencies will consider recommendations for inclusion of children prenatally exposed to cigarette smoke as eligible for Early ACCESS services, or alternatively, that those children born low birthweight or late preterm AND exposed to tobacco smoke in utero be so included.

---

[89] http://www.uihealthcare.com/depts/uichildrenshospital/childprotection/pdf/protocolonperinatalillicitdrugscreeningandintervention.pdf

Rationale:
Tobacco smoke is the most common toxin affecting infants and children – in utero as well as via second hand smoke from adults. The evidence is increasing that cigarette smoke is associated with cognitive impairments and behavioral problems. While the effects of tobacco smoke alone are not as serious as alcohol or other toxins, they are often combined with other exposures. For example, economic stresses on pregnant women who smoke have been shown to depress cognitive development of newborns at a significant level.

Children in low income families are more likely to live in a household with someone who smokes. In Iowa, 48 percent of children 0 to 5 years of age whose families were below 134 percent of the Federal poverty level lived in households with someone who smokes. Thirty five percent of all children 0 through 1 year of age, regardless of income, lived in homes with someone who smokes. Smoking by pregnant women on Medicaid is much higher than among women not on Medicaid. And smoking is correlated with prematurity and low birth weights.

One of the items on the Iowa Certificate of Live Birth is on smoking before and during pregnancy.

Given that infants and children living in poverty are more vulnerable to the impact of environmental toxins; given that material hardship negatively affects the course of woman's pregnancy and the impacts on her unborn child; given that tobacco smoke combined with these stresses is a serious neurotoxin on children in utero; and given that it is possible to identify women who smoke during their pregnancies, children born to low income mothers should receive Early ACCESS services.

Attachment 1
List of Persons Interviewed

Kenneth C. Choquette, M.S.
Retired Director or Engineering and
Environmental Health, Iowa Department
Of Public Health
Currently Environmental Engineering
And Management Consultant
1410 Pennsylvania Avenue
Des Moines, Iowa 50316

Rita M. Gergely, M. Ag.
Bureau Chief
Bureau of Lead Poisoning Prevention
Division of Environmental Health
Iowa Department of Public Health
321 E. 12th St.
Des Moines, IA 50319

Debra J. Kane, Ph.D., R.N., PHCNS-BCMCH
Epidemiologist-CDC Assignee
Iowa Department of Public Health
Lucas State Office Building
321 East 12th Street
Des Moines, Iowa 50319

Rae Miller, R.N.
Early ACCESS State Liaison & Program
Coordinator
Child Health Specialty Clinics
726 N. Carroll Street - Suite 1
Carroll, IA 51401

Jeff Murray, M.D.
Professor of Pediatrics, Pediatric
Dentistry, and Biological Sciences
Co-Director Children's Health Study
Division of Neonatology, Dept. of Pediatrics
University of Iowa
200 Hawkins Dr # C606,
Iowa City, IA 52242-1007
Iowa City, IA 52242

Don Simmons, Ph.D
Environmental Project Manager
State Hygienic Laboratory
UI Research Park - Coralville
Iowa City, IA 52242-5002
University of Iowa
Iowa City, Iowa

Peter Weyer, Ph.D.
Associate Director
Center for Health Effects of Environmental
Contamination
The University of Iowa
Bioventures Center, W140
2500 Crosspark Road
Coralville, IA 52241

Michael Wichman, Ph.D.
Environmental Lab Director
Associate Director of Environmental
Health Programs
Environmental Project Manager
State Hygienic Laboratory
UI Research Park - Coralville
Iowa City, IA 52242-5002

Meghan Wolfe
Early ACCESS Liaison
Bureau of Family Health
Iowa Department of Public Health
Lucas State Office Building
321 East 12th Street
Des Moines, Iowa 50319