

Over Exposed:

The Impacts of bisphenol A on Public Health

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EXECUTIVE SUMMARY

Bisphenol A (BPA), found in the 1930s to be a synthetic estrogen, is now a high-volume production chemical used to make epoxy resin and polycarbonate plastic. Approximately 7 billion pounds of BPA are produced globally each year for use in baby bottles, dental sealants, compact discs, water bottles, food cans, and a large variety of other items.

Due to the widespread use of BPA, human and environmental exposure to the chemical is prevalent. According to the Centers for Disease Control and Prevention, more than 90% of Americans have detectable levels of BPA in their bodies. In addition, BPA has been found in groundwater, landfill leachate, sewage sludge, and waste water discharge.

Concerns over incessant exposure to BPA have been further compounded by the growing body of scientific evidence linking the chemical to a long list of negative health effects. Low dose exposure to BPA has been linked to developmental delays, behavioral changes, reproductive disorders, cancer, diabetes, and impaired immune systems. Research also indicates that exposure to BPA during critical windows of development may result in health problems not just during infancy, but into adulthood as well.

Alternatives to BPA in food and beverage containers – the primary source of human exposure – not only exist, but are already in use. Baby and water bottle manufacturers are switching to glass, stainless steel, or other types of plastics, and companies in Japan and the U.S. are using BPA-free metal food cans.

Despite the mounting evidence of harm and the existence of safer alternatives for most applications, the federal government



has failed to act. The Food and Drug Administration (FDA) – the primary agency charged with regulating BPA – asserted the safety of BPA based on two studies, both funded by the chemical industry. In addition, the Toxic Substances Control Act - the law intended to regulate industrial chemicals in the United States - has unsuccessfully protected the public from toxins for more than 30 years.

Rather than relying on the federal government, individual states, cities, and counties have taken the lead and enacted bans on BPA. This includes Minnesota, Connecticut, Chicago, and several counties in New York. Canada also became the first government in the world to declare BPA a toxic substance and prohibit the chemical's use in baby bottles.

While the FDA continues to drag its feet, the market has seen rapid changes as the result of consumer demand. Major baby bottle manufacturers including Avent, Disney, First Years, Gerber, Dr. Brown, Playtex, and Evenflow have agreed to phase out the use of BPA in their baby bottles. Similarly, Nalgene and CamelBak now offer only BPA-free water bottles. And major retailers such as Wal-Mart and Toys "R" Us have committed to no longer selling baby bottles made with BPA.

Recommendations

Given the weight of scientific evidence showing the harmful effects of BPA, Vermont must take steps to protect public health and the environment from exposure to this synthetic estrogen. The state legislature must follow the example of Connecticut, Minnesota, and others, and prohibit the use of BPA in food and beverage containers. We must also require manufacturers to use the safest alternatives available when replacing BPA in their products.

In addition, Vermont should look beyond addressing chemicals on an individual basis. Instead, we must take a comprehensive approach to chemical regulation that uses precaution and acts when there is evidence of harm.

THE BASICS ON BPA

Bisphenol A was first synthesized in 1891 and was later discovered in the 1930s to be a synthetic estrogen.¹ At the time, scientists believed that the estrogenic properties of the chemical would be effective in managing challenging pregnancies. However, BPA's use as a pregnancy aid never came to be as another chemical -Diethyl Sylbestral (DES) - was thought to be better suited for this purpose. DES was later discovered to cause reproductive harm including vaginal cancer in the children of women who took the drug.²

Throughout the 1940s and 1950s, scientists found that BPA could be used to make epoxy resins and polycarbonate plastics. Today, roughly 7 billion pounds of BPA are used globally each year to make thousands of products.³ In the United States, five companies manufacture BPA and bring in roughly \$6 billion a year from the chemical's use. These companies include Bayer, Dow,

BPA is a synthetic estrogen that was first used as a pregnancy aid.

More than 90% of Americans have levels of BPA in their bodies, and children have higher concentrations of BPA in their bodies than adults.

Hexion Specialty Chemicals, SABIC Innovative Plastics (previously GE Plastics), and Sunoco.⁴

Common Uses of BPA

BPA is most commonly used to make polycarbonate plastic. Polycarbonate plastic products include baby bottles, water bottles, Tupperware, compact discs, and a wide variety of other items. As of 1997, 95% of baby bottles contained BPA.⁵ Similarly, polycarbonate plastic was, until recently, a popular choice among leading reusable water bottle manufacturers.

Epoxy resins constitute the second largest use of BPA. Among other applications, epoxy resins are used to coat steel and aluminum food and beverage cans to help prevent spoiling. According to the Can Manufacturers Institute, most food and beverage cans produced in the U.S. are lined with epoxy resins that contain BPA. This includes cans used for baby formula.⁶

As of 1997, 95% of baby bottles contained BPA.

DAILY EXPOSURES

Due to the widespread use of BPA, human and environmental exposure to the chemical is prevalent. BPA has been found in human breast milk, urine, serum, plasma, amniotic fluid, and placental tissue at birth.⁷ According to the Centers for Disease Control and Prevention (CDC), more than 90% of Americans have detectable levels of BPA in their bodies, and children have higher concentrations of BPA in their bodies than adolescents and adults.⁸ In fact, according to one study, premature babies in intensive care units had levels of BPA in their bodies that were ten times higher than levels found in the general public.⁹

Research indicates that prenatal exposure to BPA is significant and that the chemical is quickly absorbed and distributed in “maternal organs and fetuses through the placenta.”¹⁰ Studies indicate that effects of reproductive harm triggered in animal studies occur at levels of exposure similar to those found in women and fetuses. In one biomonitoring study, all 33 participants who submitted urine samples had BPA in their urine and 16 of the participants (14 of them women) had the synthetic estrogen in their blood. Levels of BPA in several of the participants were similar to those found to cause health effects in animal studies.¹¹

In addition to its presence in the human body, BPA is also commonly found in the environment. In fact, the synthetic estrogen is “one of the most frequently detected industrial chemicals in groundwater” and is also present in landfill leachate, surface water, sewage, sludge, and treated waste water discharge.¹² According to Environment Canada, long-term exposure to low levels of BPA can result in damage to fish and other aquatic life.¹³

Sources of Exposure

Food and Beverages

Human exposure to BPA is believed to come primarily from contaminated food and beverages.¹⁴ Food and beverage packaging made with BPA – such as plastic bottles, metal cans, and reusable storage containers – can leach the chemical into food and drinks. A study by the Harvard School of Public Health found that concentrations of BPA in urine increased by 69% when polycarbonate water bottles were used for cold beverages during the course of a week.¹⁵

BPA can also leach from infant formula cans and heated baby bottles. According to the Canadian government, the main source of exposure to BPA “for newborns and infants is through the use of polycarbonate baby bottles when they are exposed to high temperatures and the

The main source of exposure to BPA for newborns and infants is through the use of BPA-containing baby bottles and infant formula cans.





Approximately, 17% of the American diet is made up of canned food.

migration of BPA from cans into infant formula.”¹⁶ Baby bottles that have been found to leach BPA include well-known brands such as Avent, Disney/ The First Years, Dr. Brown’s, Evenflo, Gerber, and Playtex. An independent study found that the levels of BPA that leached from these bottles were “within the range shown to cause harm in animal studies.”¹⁷

Canned food and beverages – including infant formula, fruits, soups, and other items - are also sources of BPA exposure. Approximately, 17% of the American diet is made up of canned food.¹⁸ According to one independent study, BPA was detected in over half of the 97 cans of name-brand fruit, vegetable, soda, and other foods tested.¹⁹ The highest levels of BPA were found in chicken soup, infant formula, and ravioli - foods commonly eaten by children.

Soft drink containers can also leach BPA. In a survey done by Health Canada which represented 84% of canned soft drinks

sold in the country, BPA was found in 96% of the beverages tested. This survey proved false a long-time claim by the soft-drink industry that their products don’t expose consumers to BPA.²⁰

Other Sources

Although contaminated food and beverage containers are commonly understood to be the primary source of exposure to BPA, new research indicates that nonfood sources of the chemical could be more problematic than originally thought. Researchers at the University of Rochester examined U.S. CDC data and found that even when people fasted for an entire day, elevated levels of BPA remained in their bodies.²¹ This suggests that people are either constantly being exposed to nonfood sources of the chemical – such as plastic water pipes or carbonless paper - or that previous beliefs about the body’s ability to eliminate BPA were wrong, or both. Other products that contain the synthetic estrogen include compact discs, dental sealants, DVDs, chocolate molds, and paints.²²

HEALTH EFFECTS

Concerns over our incessant exposure to BPA have been further compounded by the growing body of scientific evidence linking the chemical to a long list of negative health effects. According to a 38-member expert panel sponsored by the U.S. National Institute of Environmental Health Sciences, “recent trends in human diseases relate to adverse effects observed in experimental animals exposed to low doses of BPA.”²³ This growing list of maladies include developmental and behavioral problems, reproductive issues, cancer, diabetes, obesity, and other health effects. As of 2005, 119 government-funded studies on low dose exposures to BPA have been conducted. Over 90% of these studies resulted in adverse health effects.²⁴

“Of the more than 100 independently funded experiments on BPA, about 90% have found evidence of adverse health effects at levels similar to human exposure. On the other hand, every single industry-funded study ever conducted – 14 in all – has found no such effects.”

Source: Case, David. The Real Story Behind Bisphenol A. Fast Company Magazine. January 14, 2009.

The Toxicity of Low Doses

In the late 1980s, the U.S. Environmental Protection Agency (EPA) established a “reference dose” (RfD), or an acceptable daily intake, of 50 µg/kg/day for BPA. According to the EPA, people could be exposed to this level of BPA everyday of their lives and would still be protected from the potential health effects of the chemical. However, constantly emerging research shows that negative health effects occur at levels of exposure below the EPA RfD.²⁵

In fact, recent research suggests that low doses of BPA may be even more harmful than acute exposures. For example, one study revealed that animals exposed to low doses of BPA experienced a 70% higher growth rate of cancerous cells than those who were exposed to high doses.²⁶

Developmental & Behavioral Issues

Low doses of BPA have resulted in hyperactivity²⁷, altered maternal behavior²⁸, changes in male infant behavior²⁹, impaired learning³⁰, and delayed development³¹. In a study examining the impacts of BPA on tadpoles, tadpoles were exposed to levels of BPA similar to those found in human infants. BPA was determined to disrupt the thyroid hormone - responsible for guiding development in tadpoles as well as in people – and kept certain genes from being expressed. As a result, the tadpoles experienced delays in development.³²

Reproductive Disorders

The impacts of BPA on reproductive health have been well documented. As a synthetic estrogen, BPA can disrupt the delicate balance of the body’s hormone system, altering its development. Research indicates that women who experience recurrent miscarriages have higher levels of BPA in their blood serum than women who successfully carry to term.³³ Similarly, links have been made between BPA in blood and ovarian dysfunction.³⁴

Other effects of low dose exposure to BPA include abnormalities in female eggs³⁵, early onset puberty³⁶, altered mammary gland development³⁷, impaired growth and function of ovarian follicles³⁸, and early vaginal opening.³⁹ Males are also vulnerable to BPA exposure. Studies indicate that low doses of the synthetic estrogen can result in reduced sperm count⁴⁰, increased anogenital distance⁴¹, and impacts on the testis.⁴²

Effects of BPA at a glance:

- **Impaired learning**
- **Delayed development**
- **Recurrent miscarriages**
- **Fertility problems**
- **Early onset puberty**
- **Cancer**
- **Resistance to chemotherapy**
- **Heart disease**
- **Diabetes**
- **Obesity**



Cancer

BPA has also been linked to breast and prostate cancers. In a study done by the University of Alabama at Birmingham, BPA induced mammary cancer in rats after the rodents were exposed to levels of BPA similar to those experienced by humans.⁴³ Another study found that adult rats exposed to BPA after birth were more likely to develop prostate cancer.⁴⁴

In addition, BPA has been found to reduce the effectiveness of chemotherapy treatments. The study, conducted by the Department of Cancer and Cell Biology at the University of Cincinnati, exposed human breast cells to environmentally relevant levels of BPA.⁴⁵ As a result, researchers found that BPA was “acting in cancer cells similar to the way estrogen works by inducing proteins that encourage chemotherapy resistance.”⁴⁶

Heart Problems, Diabetes & Obesity

Several studies have linked BPA to insulin resistance which is connected to

diabetes and heart disease.^{47,48} In the first large-scale study on the effects of the chemical on humans, researchers examined U.S. CDC data on 1,455 people and found levels of BPA in their urine that were below levels declared safe by the federal government. Researchers concluded that of these people, those with higher levels of BPA in their bodies were more likely to have cardiovascular disease, diabetes, and liver abnormalities.⁴⁹

Evidence linking BPA to obesity is also building. In one study, exposure to BPA before and after birth led mice to become obese.⁵⁰ In addition, early life exposures to endocrine disruptors such as BPA are believed to contribute to weight gain later in life.⁵¹

The synthetic estrogen has also been linked to heart arrhythmias – disturbances in the rhythm of the heartbeat. Exposure to elevated levels of estrogen during pregnancy increases a woman’s vulnerability to arrhythmias. Researchers from the University of Ohio have found that BPA’s impact on arrhythmia risk is nearly identical to the impact caused by estrogen. The study found that rodent hearts exposed to BPA had “pockets of cells that refused to beat in concert with others.”⁵² This problem intensified when the hearts were exposed to both BPA and estrogen.

Developmental Origins of Adult Health & Disease

During early stages of development, there is a complex interaction between genes and the environment which can determine how the body responds throughout its life. During this time, exposure to chemicals, such as BPA, can impact which genes are expressed and which are not.⁵³ BPA can result in the altered behavior of over 200 genes.⁵⁴

BPA can result in the altered behavior of over 200 genes.

Mounting scientific evidence suggests that exposure to BPA during critical windows of development does, in fact, lead to health problems later in life. According to a scientific panel sponsored by the U.S. National Institute of Environmental Health Sciences, “these developmental effects are irreversible and can occur due to low-dose exposure during brief sensitive periods in development, even though no BPA may be detected when the damage or disease is expressed.”⁵⁵ For example, one study found that animals exposed to carcinogens later in life were more likely to develop mammary tumors if they received prenatal exposure to BPA.⁵⁶

ALTERNATIVES TO BPA

Alternatives to BPA in food and beverage containers – the primary source of human exposure – not only exist, but are already in use. With growing frequency, manufacturers are producing BPA-free products and seeing benefits to their bottom lines. Retailers have also joined the ranks by refusing to sell items containing BPA. This includes - among others- Wal-Mart, Toys “R” Us, and Whole Foods who have decided they will no longer sell BPA-tainted baby bottles, and Patagonia, Inc. who stopped selling polycarbonate water bottles.

Baby Bottles

BPA-free baby bottles are readily available on store shelves. In fact, six major baby bottle manufacturers - including Avent, Disney, First Years, Gerber, Dr. Brown, Playtex, and Evenflow - announced in March that they

will no longer be using BPA in their products.⁵⁷ Glass is a common and popular alternative for replacing the synthetic estrogen in baby bottles. For those parents concerned with breakage, many bottles come with silicone sleeves to protect against this. Plastic alternatives such as polyamide, used by Born Free, also exist.⁵⁸

Infant Formula and Baby Food

Manufacturers of infant formula and baby foods have also begun to shift away from the use of BPA. According to Nestle, more than 80% of their infant formula is sold in BPA-free packaging.⁵⁹ Similarly, all Similac powdered infant formula products are now BPA-free⁶⁰ and BPA is not used in “the plastic cups for Gerber pureed baby food products.⁶¹ In addition, “Enfamil LIPIL® Single Serve powder packaging, Enfamil® Human Milk Fortifier packaging, and the nipples Mead Johnson distributes do not contain BPA.”⁶²

Water Bottles

Major water bottle manufacturers including Nalgene and CamelBak have stopped using polycarbonate plastics. Instead, many manufacturers are opting for stainless steel, aluminum, or an alternative plastic called Tritan copolyester. Kleen Kanteen, for example, produces an unlined stainless steel bottle that removes any risk of exposure to BPA.⁶³



The market is shifting away from the use of BPA

Retailers that no longer sell baby bottles made with BPA:

Wal-Mart
Toys “R” Us
Whole Foods
Rite Aid Corporation

Companies that no longer sell water bottles made with BPA:

Patagonia
Kleen Kanteen
Nalgene
CamelBak
Polar Bottle

Baby bottle manufacturers that no longer use BPA:

Born Free
Avent
Disney
First Years
Gerber
Dr. Brown
Playtex
Evenflow

Food companies that use BPA-free alternatives for some products:

Liz Lovely Cookies
Heinz
Eden Foods
Vital Choice

Baby food manufacturers that offer some BPA-free products:

Nestle
Similac
Enfamil
Gerber

Spotlight on Liz Lovely Cookies in Vermont

Liz Lovely is a Vermont-based vegan cookie company with a mission to provide “uncompromising commitment to perfection, and a relentless approach to social responsibility.”

The company, a true Vermont success story, uses BPA-free packaging.

More information on green packaging used by Liz Lovely Cookies can be found at:

<http://www.lizlovely.com/whatwereabout/greenpackaging.php>



Food Cans

In food packaging, BPA (in the form of epoxy resin) is most often used to line the inside of steel and aluminum cans.⁶⁴ While alternative linings do exist, finding a suitable replacement for all applications is a challenge due to the corrosive nature of highly acidic foods. For example, Eden Foods – an organic food company in the United States – uses a natural blend of oil and resin extracted from plants such as the balsam fir. While this BPA-free coating works well for foods like beans and potatoes, it does not stand up to the acidity of tomatoes.⁶⁵

Other alternatives have also been used extensively in Japan. For the last ten years, Japanese can manufacturers have been using alternatives such as polyester-based coatings, only using BPA when needed as an undercoating adhesive.⁶⁶ As a result, Japan has significantly reduced the amount of BPA leaching from their food and beverage cans. In fact, Japanese cans leach only 5% as much BPA as cans in the United States.⁶⁷

REGULATIONS

Current Regulations in the U.S.

Food and Drug Administration

Despite the overwhelming scientific evidence linking BPA to toxic effects and the existence of safer alternatives for most applications, the federal government has failed to act. The FDA – the primary agency charged with regulating BPA – continues to maintain the safety of the chemical, disregarding more than 100 published studies by government scientists and university laboratories that have demonstrated adverse health effects. The FDA's assessment is based primarily on two studies, both of which are funded by the American Plastics Council, an industry trade group.⁶⁸

The FDA's assessment that BPA is safe is based primarily on two studies, both of which are funded by the American Plastics Council.

The FDA has maintained its position despite being criticized by the agency's own panel of independent science advisers for ignoring available data on the health risks of BPA.⁶⁹ The FDA's position is also contradicted by two reports sponsored by the National Institute of Environmental Health Sciences (NIEHS) finding the health



impacts of BPA to be cause for concern. According to one of the NIEHS studies: “The wide range of adverse effects of low doses of BPA in laboratory animals exposed both during development and in adulthood is a great cause for concern with regard to the potential for similar adverse effects in humans.”⁷⁰

Under the Obama administration, the FDA has promised to take a “fresh look” at the issue.⁷¹ According to Jesse Goodman, the Agency's acting chief

medical officer, this review will include a broader scope of scientific opinions. The FDA was expected to complete its review and make a decision as to whether BPA is safe for use in food and beverage containers by November 30th.⁷² However, this deadline has come and gone and the agency has yet to make a determination.

Toxic Substances Control Act

The federal government's failure to act on BPA is symptomatic of the country's ailing policy designed to regulate the more than 80,000 chemicals currently in use. In 1976, the federal government passed the Toxic Substances Control Act (TSCA) in an attempt to better regulate chemicals in the U.S. However, TSCA grandfathered in 62,000 chemicals – including BPA - and does not require the EPA to assess the risk of these chemicals. Instead, the EPA may only require toxicity data if the agency is able to show “substantial evidence” that potential harm already exists.⁷³ Similarly, TSCA does not require that new chemicals be tested for safety either. Since TSCA became law, the EPA has only restricted the use of five chemicals and has required testing for less than 200 chemicals.⁷⁴ The egregious loopholes, the onerous burden of proof placed on the EPA, and the record of EPA inactivity, has left many believing that TSCA is the most ineffective environmental law in the country.

Taking Action on BPA

Canada

After conducting a screening assessment of BPA, the Canadian government took steps to reduce BPA exposure in infants and newborns by banning the importation, sale, and advertising of polycarbonate baby bottles.⁷⁵ In addition, Canada has also committed itself to establishing “stringent” migration standards for BPA in infant formula cans,



and collaborating with the food industry to develop packaging alternatives.⁷⁶

States and Counties Taking the Lead

In the last year, states working to protect the health of children from BPA have made extraordinary progress. Minnesota was the first state in the country to ban the synthetic estrogen, prohibiting its use in baby bottles and sippy cups.⁷⁷ Connecticut soon followed, passing an even more extensive law that prohibits the use of BPA in baby bottles, infant formula and baby food jars and cans, and reusable food and beverage containers.⁷⁸ And the Massachusetts Department of Public Health recently issued a public health advisory on BPA. The advisory recommends that parents of children two years and younger as well as pregnant women avoid food and beverage containers with BPA.⁷⁹

Governments that have banned BPA

Canada

Minnesota

Connecticut

Chicago, Illinois

Albany County, New York

Schenectady County, New York

Suffolk County, New York

In addition to states, cities and towns are also taking action. The city of Chicago as well as three New York counties (Albany, Schenectady, and Suffolk) established policies that restrict the sale of BPA-tainted baby bottles and sippy cups.

These victories are likely only the beginning as a handful of other states including Vermont, Maine, New York, California, Maryland, and Washington will be introducing similar bills this coming year.

RECOMMENDATIONS FOR VERMONT

Prohibit the Use of BPA in Vermont

Given the overwhelming amount of scientific evidence showing the harmful effects of BPA, Vermont must take steps to protect public health and the environment from exposure to this synthetic estrogen. The state legislature must follow the example of Connecticut, Minnesota, and others, and prohibit the use of BPA in baby bottles, sippy cups, and other food and beverage containers. We must also require manufacturers to use the safest alternatives available when replacing BPA in their products.

Establish a System for Comprehensive Chemical Reform in Vermont

In addition, Vermont should look beyond addressing chemicals on an individual basis. Instead, we must take a comprehensive approach to chemical regulation that uses precaution and acts when there is evidence of harm. Due to a previous lack of movement at the federal level, other states -such as Maine - have enacted laws that identify chemicals of high concern and target the most toxic for phase out or other forms of regulation. Vermont can and should do the same. We must identify the most harmful chemicals; require manufacturers to submit environmental and toxicity data on their chemicals; use precaution and act to protect public health when there is credible evidence of harm; and prohibit the use of toxins when safer alternatives are available.

Although a change of administration at the federal level has left open the possibility of reforming our outdated methods of regulating chemicals, states are still driving the national dialogue. By banning BPA and establishing a protective and effective chemicals policy, Vermont can both protect the health of our families and impact change on the national stage.

Vermont Organizations that Support Banning BPA

Informed Green Solutions

Mama Says

Planned Parenthood of Northern New England

Toxics Action Center

Vermont Public Interest Research Group

Voices for Vermont's Children

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