HEALTHCARE PROVIDER GUIDE: Phthalates and Bisphenol A

Phthalates and bisphenol A (BPA) are man-made chemicals that are known endocrine disruptors. They can affect hormones such as estrogen and testosterone, and potentially disrupt normal growth and development. Historically, discussions of sources of phthalate and BPA exposure focused on plastics; but current research highlights several sources of exposure including food, personal care products, and dust.

Phthalates

Phthalates are man-made chemicals that give flexibility to soft plastics and polyvinyl chloride (PVC) products, and are used in a variety of personal care products (i.e. shampoos, lotions, makeup, perfume). They can be found in plastic medical devices (i.e. IV tubing, IV fluid/ total parenteral nutrition bags, catheters) and in some time-released medications. They can also be present in the US food supply as contaminants (i.e. from plastics used in conveyer belts, jar lids, tubes storing food, gloves, packaging, storage). Processed foods and high fat dairy and meats are particularly high in phthalates.

Bisphenol A (BPA)

Bisphenol A is a man-made chemical that gives rigidity to hard, polycarbonate plastics and is also used in food can linings (to prevent degradation of the metal) and in thermal /carbonless receipts (to stabilize ink). BPA can also come from dental sealants that are applied in the dentist's office.

- The majority of the US population is exposed to phthalates and BPA[i]
- The major sources of phthalates and BPA exposure for the general population are food (especially those high in animal fats, highly processed, or canned foods), personal care products, and dust.[ii] Phthalates and BPA leach out of plastics (food containers, packaging, can linings, kitchen accessories) and into food and dust. This is more likely to occur when the product is heated.
- Children are exposed to phthalates and bisphenol A from ingestion (contaminated food and drink), inhalation (dust), and dermal absorption (personal care products). Main exposure sources can vary by age, developmental stage and individual behaviors.
- Early childhood or fetal exposure to these chemicals, during important developmental windows, may have lasting effects throughout life. Infants and toddlers can have higher intakes of these chemicals compared to adults because of their increased food/water requirements per unit body mass, hand-to-mouth activity, and ventilation rate.
- The Pediatric Environmental Health Specialty Units (PEHSU) recommend a precautionary approach. The information below will summarize health effects and help reduce exposures.

Possible Human Health Impacts:

Both phthalates and bisphenol A interfere with the production and function of hormones in animal studies and may increase the risk of a wide variety of adverse health effects. Current research is ongoing to determine definitive health impacts in humans.

Phthalates

These chemicals are anti-androgenic and can adversely impact androgen-sensitive tissues (ex. testicular function and genital development). They may also impact behavior, change pubertal development, and can increase the risk of allergies.

Animal Toxicologic Studies (all are high dose exposures in utero)

- Testicular toxicity in utero and in early development (testicular dysgenesis syndrome)[iii]
- Male reproductive tract abnormalities in offspring of prenatally exposed rats including decreased anogenital distance, hypospadias, cryptorchidism, and testicular tumors[iv]
- Decreased birth weight after prenatal exposure[v]
- Malignant liver tumors (not thought to be relevant to human exposures)[vi]

Human Epidemiologic Studies

- Prenatal exposure associated with a decreased anogenital distance (marker of androgenization)[vii]
- Exposure through breast milk has been associated with increased LH, decreased free testosterone and increased serum human binding globulin in 3 month old male infants[viii]
- Early childhood exposure may increase the risk of increased rhinitis, eczema, asthma and wheezing[ix]
- Prenatal exposure may increase the risk of alterations in infant/toddler physical development as well as increased externalizing (hyperactivity and aggression) and autistic-like child behavior[x]
- In adult males, concurrent exposure may increase the risk for abnormal sperm morphology/sperm DNA damage[xi]

Bisphenol A

BPA acts as a weak estrogen. It has chemical properties similar to estradiol and can impact biological systems in **very low doses** potentially resulting in behavior, reproductive, and metabolic disorders.

Animal Toxicologic Studies[xii]

- Prenatal exposures lead to changes in behavior including hyperactivity, increased aggression, impaired learning[xiii]
- Low dose prenatal exposure associated with early puberty and increased mammary tumors in offspring, increased risk of prostate hypertrophy[xiv]
- Prenatal exposure associated with increased adipocytes and increased body weight in offspring[xv]
- Adult and prenatal exposure associated with modulation of helper T1 and T2 cells which in turn adversely affects antibody production[xvi]

Human Epidemiologic Studies

- Evidence that humans are exposed to concentrations similar or higher than doses used in several animal studies that document adverse health effects[xvii]
- Prenatal BPA exposure has shown to have increased risk of externalizing (hyperactivity and aggression) in 2 year old female children[xviii]
- Higher urinary BPA levels associated with delayed onset of breast development in girls[xix]
- Associated with obesity and asthma[xx]
- In adults, crossectional studies found associations between higher BPA exposure and increased risk of cardiovascular diagnoses, abnormal liver enzymes, and diabetes diagnosis[xxi]

What's the Bottom Line?

Scientists and healthcare providers are concerned about phthalates and BPA because they are widely prevalent in every-day products, and universal exposures in the US population have been documented. The full extent of their potential health impacts is still unknown, but research supports a potential role in a wide range of health conditions. Until more is known, it is best to take a precautionary approach by preventing and reducing phthalate and BPA exposures.

Tips on Teaching Patients & Parents How to Reduce Exposure:

Disclaimer: Based upon interpretation of the current literature, the PEHSU program is providing this guidance for persons who wish to take a precautionary approach to personal decisions, and is not meant to substitute for personal medical consultation with your health care provider.

1. **Buy low fat dairy products such as skim milk and low fat cheeses.** Avoid high fat foods such as cream, whole milk, and fatty meats as much as possible.
2. **Buy fresh or frozen fruits and vegetables when possible. Avoid canned and processed foods.**
3. When possible, purchase items that are phthalate free or BPA free.
4. Minimize personal care product use. Keep it simple, less is more.
5. Use glass, stainless steel, ceramic, or wood to hold and store foods instead of plastics.
6. Do not microwave food/beverages in plastic.
7. If using hard polycarbonate plastics (found in some water bottles/baby bottls/sippy cups), do not use for warm/hot liquids.
8. If plastics cannot be avoided, use the following guide to avoid particularly dangerous plastics. Check the symbol on the bottom of plastics containers and try to avoid the plastics marked 3 (PVC or vinyl), 6 (polystyrene foam), or 7 (other, can contain BPA)[1]:

9. Encourage frequent handwashing.
10. Minimize handling of receipts.
11. Take shoes off at home to avoid tracking in dust that may contain these chemicals.
12. Keep carpets/windowsills clean - vacuum and wet dust frequently to minimize dust that may contain these chemicals.

You or your patients may contact your local Pediatric Environmental Health Specialty Unit. Find our contact information at www.aoec.org/PEHSU.htm or call 1-888-347-2632.

Resources

American Academy of Pediatrics Council on Environmental Health. Etzel R, ed. *Pediatric Environmental Health*. 3rd ed. Elk Grove Village, IL: American Academy of Pediatrics; 2012. *(aka, AAP Green Book)*

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[1] Code #6: Styrene, a potentially toxic chemical, may be released from containers made from polystyrene foam (Styrofoam and related brands) when they are used to heat or store foods or liquids at temperatures exceeding 80°C (176°F). Code #7 covers "other" plastics, which includes polycarbonate. Therefore not all code #7 plastic bottles contain polycarbonate and leach BPA. Also, BPA can be given off from other products.

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[i] Centers for Disease Control and Prevention. Fourth Report on Human Exposure to Environmental Chemicals, 2009. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. http://www.cdc.gov/exposurereport/

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