

OREGON PUBLIC HEALTH DIVISION • OREGON HEALTH AUTHORITY

WHAT'S ALL THIS FUSS ABOUT BISPENOL A?

Mr. McGuire: I want to say one word to you. Just one word.

Benjamin: Yes, sir.

Mr. McGuire: Are you listening?

Benjamin: Yes, I am.

Mr. McGuire: Plastics.

The Graduate, 1967

A QUIZ*

1. True or false? In Oregon, the Willamette River is the most significant source of bisphenol A exposure as a result of industrial practices during the latter 20th century?
2. True or false? Multnomah County adopted a policy in 2011 restricting the sale of reusable beverage containers (including baby bottles) made with bisphenol A?
3. Choose the correct answer. One important way to limit one's exposure to bisphenol A is:
 - a. Minimizing the amount of large, resident species of fish from the Willamette River consumed.
 - b. Wearing a respirator when preparing a house for painting.
 - c. Washing one's hands after handling receipts from cash registers.
4. True or false? The median U.S. urinary bisphenol A concentration increases with age.

THE SETUP

This is Oregon after all. We know you've had questions from your patients. So this week, *CD Summary* ventures into toxicology to explicate the mystery of bisphenol A. What is it? Where does it come from? Should we worry? Let's get this out of the way first: exercise, don't smoke, wear your seatbelt, lose weight, get tested for HIV, get immunized. Now...

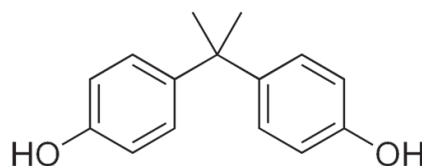
...Bisphenol A, BPA for short, is an endocrine disruptor which is "any chemical (including dietary) or physical agent that modulates one or several of the endocrine organs or the function of these organs."[†] More specifically, BPA can activate estrogen receptors, though, thankfully not as efficiently

as estrogen itself. Given to pregnant rodents, even relatively low doses of BPA can cause behavior changes, abnormal prostate and mammary growth, and disruption of puberty in offspring.¹ BPA hasn't been conclusively linked to disease in people yet, but data from NHANES[‡] show an association between high urinary levels of BPA and some chronic diseases.² So far as reasonably possible, we believe that limiting exposure to BPA is prudent. Especially if one is an infant or a fetus.[§]

A BIT OF CHEMISTRY

Patently apparent from its name, bisphenol A has two phenol rings in a pleasingly symmetric arrangement with two hydroxyl and two methyl groups (Figure 1). It has been widely used for at least 50 years to make polycarbonate polymers and epoxy resins in products such as hard plastic water bottles, compact disks, baby bottles, automobile parts, plastic dinner ware, dental composites, and thermal receipt paper.³ The most common source of exposure for the general population is believed to be canned foods into which BPA from the epoxy can linings leaches in measureable quantities (<0.2–1,140 parts per billion) during processing.^{4,5¶}

Figure 1. Bisphenol A chemical structure



Ubiquitous as these products are, you won't be surprised to learn that 93% percent of us have detectable levels of bisphenol A in our urine.⁶ Unlike other more biologically persistent toxins, BPA is rapidly cleared from the

‡National Health and Nutrition Survey
§ Consistent with the U.S. Food and Drug Administration and Canadian national policy.

¶ See analyses in "No Silver Lining Report", available at <http://ej4all.org/contaminatedwithoutconsent/nosilverlining.php>

body—within 24 hours—so, the high prevalence of detectable levels substantiates constant exposure (see Table 1).⁷ Children and adolescents have higher urinary BPA levels than adults and men have higher levels than women (not shown).^{6,8}

So how much is too much? No one knows for sure but National Toxicology Program (in the Department of Health and Human Services) and others have estimated overall oral doses from all sources in various age groups (See Table 2, *verso*).

Table 1. Creatinine-adjusted urinary bisphenol A in the general U.S. population, 2007–2008

Age (yrs.)	Median urinary bisphenol A concentration (µg/L)*
6–11	2.4
12–19	2.3
≥20	2.0

* µg/L = micrograms per liter

REGULATIONS

In Oregon, Senate Bill 695 restricting BPA in infant formula and baby bottles was introduced but failed to pass the state legislature during the 2011 session. However, in October 2011, the Multnomah County Board of Health voted (5–0) to restrict the sale of any reusable beverage container for adults or children (including baby bottles) that is made with BPA in Multnomah County. Even in the absence of regulation, some large retailers, such as Wal-Mart and Babies R Us and others have voluntarily phased out BPA from their baby bottles, pacifiers and other baby feeding products. Nalgene and Campbells^{**}, among other manufacturers, have voluntarily removed BPA from their products.⁹

WAYS TO REDUCE EXPOSURE

Individual citizens can reduce bisphenol A exposure by ingesting fewer canned foods and beverages (Figure 2, *verso*). If you are a retail worker who handles a lot of receipts printed on carbonless (or thermal) copy paper which contains BPA, you can also reduce your exposure by washing your hands between handling receipts and

** http://e360.yale.edu/digest/campells_to_stop_using_chemical_bpa_in_lining_of_soup_cans/3362/

* Answers at end

† Gale Encyclopedia of Public Health



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eating.¹⁰ The best way to reduce infants' exposure to bisphenol A is to breast-feed. If that isn't possible, parents can look for BPA-free or "no BPA-added" infant formula cans. Also, reconstituted canned powdered infant formula has consistently lower bisphenol A concentrations than canned liquid (ready to use) formulas.¹¹ Parents can also look for bottles, pacifiers, and teething rings that are BPA-free.

QUIZ ANSWERS:

1. Blatantly false. Use of the Willamette as an industrial toilet was, sadly, common at one time. However the chemical legacy of these activities consists of more environmentally persistent chemicals than BPA, such as polychlorinated biphenyls (PCBs), dioxins, and dichlorodiphenyltrichloroethane (DDT).
2. True.
3. While a) isn't a bad idea for women of child-bearing age, and b) is a great idea for reducing the potential for environmental lead exposure, the correct answer is c).
4. False. See Table 1.

ADDITIONAL RESOURCES

- National Institute of Environmental Health Sciences and National Toxicology Program: www.niehs.nih.gov/news/sya/sya-bpa/.
- EPA's reference dose as presented in the Integrated Risk Information System (IRIS): www.epa.gov/iris/subst/0356.htm
- EPA's Action Plan for Bisphenol A: www.epa.gov/oppt/existingchemicals/pubs/actionplans/bpa.html
- Multnomah County BPA Ban: <http://web.multco.us/bpa>

REFERENCES

1. Center for the Evaluation of Risks to Human Reproduction. NTP-CERHR monograph on the potential human reproductive and developmental effects of

Table 2. Typical daily intake of bisphenol A and maximum safe intakes according to various government agencies (µg/kg-day = micrograms BPA per kilogram body weight per day).

Group	Estimated average daily intake	Maximum "safe" daily dose, EPA and EFSA	Maximum "safe" daily dose, Health Canada	Dose of observed effect in rodents reported by NTP
Formula-fed infants	1.0–11.0*	50	25	2**
Breast-fed infants	0.2–1*	50	25	2**
Toddlers	0.04–14.7*	50	25	2**
Kids 6–11	0.05†	50	25	2**
Adolescents	0.05†	50	25	2**
Adults	0.04†	50	25	2**

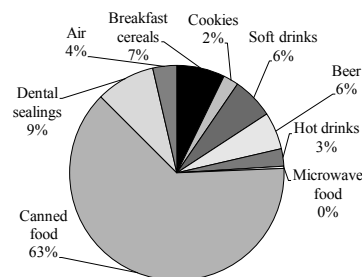
EPA = U.S. Environmental Protection Agency Reference Dose (RfD); EFSA = European Food Safety Authority Tolerable Daily Intake (TDI); NTP = U.S. National Toxicology Program

*From [1]; †From [7] – estimated median dose

** From [1] Yes, these value are indeed 12.5 and 25 times greater than the U.S. and Canadian "safe" doses respectively. If the more recent NTP studies were to be used as the reference, the "safe" levels would probably range from 0.07- 0.02 µg/kg-day

2. bisphenol A. Report No. 08-5994. Triangle Park, NC: National Institutes of Health; 2008.
3. Lang IA, Galloway TS, Scarlett A, et al. Association of urinary bisphenol A concentration with medical disorders and laboratory abnormalities in adults. *JAMA* 2008;300:1303–10.
4. Centers for Disease Prevention and Control. Fourth national report on human exposure to environmental chemicals. 2009: Atlanta, GA.
5. Schechter A, Malik N, Haffner D, et al. Bisphenol A (BPA) in U.S. food. *Environ Sci Technol* 2010;44:9425–30.
6. Von Goetz N, Wormuth M, Scheringer M, Hungerbühler K. Bisphenol A: How the most relevant exposure sources contribute to total consumer exposure. *Risk Analysis* 2010;30:473–87.
7. Calafat AM, Ye X, Wong LY, Reidy JA, Needham LL. Exposure of the U.S. population to bisphenol A and 4-tertiary-octylphenol: 2003–2004. *Environ Health Perspect* 2008;116:39–44.
8. Stahlhut RW, Welshons WV, Swan, SH. Bisphenol A data in NHANES suggest longer than expected half-life, substantial nonfood exposure, or both. *Environ Health Perspect* 2009;117:784–9.
9. Lakind JS, Naiman DQ. Daily intake of bisphenol A and potential sources of exposure: 2005–2006 National Health and Nutrition Examination Survey. *J Expo Sci Environ Epidemiol* 2011;21:272–9.

Figure 2. Relative source contribution to total daily dose of BPA for the average adult⁴



9. WebMD. Stores to pull bisphenol A baby bottles. 2008 Available from: <http://children.webmd.com/news/20080421/stores-pull-bisphenol-a-baby-bottles>. (Accessed: 27 Feb, 2012).
10. Lunder S, Andrews D, Houlihan J. Synthetic estrogen BPA coats cash register receipts. July 27, 2010 Available from: www.ewg.org/bpa-in-store-receipts. (Accessed: 27 Feb 2012).
11. Ackerman LK, Noonan GO, Heiserman WM, Roach JA, Limm W, Begley TH. Determination of bisphenol A in U.S. infant formulas: updated methods and concentrations. *J Agric Food Chem* 2010;58:2307–13.