BPA and related chemicals: why worry?

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Sources of Exposure

Changes in the composition of can coating

Graph showing BPA concentration in urine (ng/ml) vs. number of subjects (2, 13, 19, 16) and coffee and tea consumption (A, B, C, D).
BPA is an endocrine disruptor

EDCs are exogenous chemicals or chemical mixtures that interfere in some way with hormone action.

Bisphenol-A (BPA) Estradiol
Some chemicals from the “families” above are potentially endocrine disrupters.
Understanding EDCs requires an understanding of hormones.
Hormones act at low doses
Hormones act via receptors

“potency” is endpoint specific
Hormones can have non-monotonic dose responses.

There are hundreds of examples from the hormone and EDC literature where the dose does not make the poison. Our review concludes that these types of U- and inverted U-shaped curves are common and should be expected.
Hormone action is dependent on timing of exposure

“From the day of conception until an individual is born or hatched, the development of each stage of life is fully under the control of hormones. Changes that happen during development are far less reversible [than those occurring in an adult]; you can't go back and rewire the brain”.

- Theodora Colborn, zoologist, writer
Early Prenatal | Mid- Late Prenatal | Postnatal
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**Central nervous system** (3wks - 20 years)
- Ear (4-20 wks)
- Kidneys (4-40 wks)
- Heart (3-8)
- Limbs (4-8wks)
**Immune system** (8-40 wks; competence & memory birth-10yrs)
- Skeleton (1-12 wks)
**Lungs** (3-40 wks; alveoli birth-10yrs)
**Reproductive system** (7-40wks; maturation in puberty)

Week 1-16 | Week 17-40 | Birth – 25 years
Early Life Exposure to EDCs

The effects of early exposures to EDCs – when organ systems are developing – may be manifested any time in life.
Over recent decades there has been:

- significant increase in **reproductive problems** in some regions of the world, suggesting a strong role for unidentified environmental factors in disease etiology
- increase in **endocrine cancers**
- significant decrease in **human fertility** rates
- increase in use of assisted reproductive services
- increasing number of chemicals to which all humans in industrialized areas are exposed

Top: Richiardi et al., Cancer Epidem. Biomark. (2004);
Bottom: based on data from http://data.euro.who.int/hfadb/
Back to BPA… What does it do?
Effects of BPA in animals

cancers (prostate, mammary)
fertility
immune system
metabolic syndrome
reproductive aging
hormone levels
brain
Behaviors (sex specific, maternal, aggression, hyperactivity)
pancreas
mammary gland
obesity
male reproductive tract
female reproductive tract
cardiovascular
metabolic syndrome
BPA & the mammary gland

Tharp et al. 2012

Durando et al. 2007

Markey et al. 2001

Vandenberg et al. 2007

Acevedo et al. 2013
Effects of BPA in humans

- Obesity
- Abnormal behaviors
- Cardiovascular diseases
- Metabolic syndrome
- Hormone levels
- Infertility
- PCOS
BPA replacements

[Chemical structures of BPA replacements]
Changing how we test EDCs?

- Without appropriate testing, ‘safety’ should not be assumed.
- ‘Positive’ effects should trigger chemical abandonment.