Everyday Chemical Exposures and Breast Cancer:
Why are we concerned? What can we do?

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General Risks Factors Associated with Cancer

• **Genes**
  - Primary mutations (e.g., *BRCA1*, *BRCA2*)
  - Polygenic and/or multiple allelic profiles
  - Epigenetic changes

• **Lifestyle**
  - Diet
  - Exercise
  - Body mass/obesity
  - Alcohol intake
  - Smoking history & exposure
Other Risks Factors Associated with Breast Cancer

• **Reproductive history**
  • Age at menarche
  • Age at menopause
  • Age of first full-term pregnancy
  • Breastfeeding history
  • HRT or oral contraceptive history

  ➔ **Lifetime exposure to estrogens, especially estradiol**

• **Other Endocrine Factors**
  • Progesterone
  • Androgens
  • Thyroid hormones
  • IGF-1 and other growth factors
Other Risks Factors Associated with Breast Cancer

- Environmental toxicants
  - Radiation, including medical radiation
  - Known and recognized carcinogens
- Endocrine Disrupting Compounds (EDCs)
- Risk factors for disease do not act in isolation
Environmental chemicals in our environment

- ~ 85,000 registered synthetic chemicals
- ~ 1000 new chemicals each year
- Toxicological data for only ~ 7%
- No human health data for at least 90% of these chemicals
Environmental chemicals in our environment

- Lack of strong regulation in the US
  - **1976**: Toxic Substances Control Act (TSCA)
    - 62,000 chemicals “grandfathered” in without testing
    - Bisphenol A (BPA) is one of them
  - **2012-2104**: Failed attempts at reform
Environmental chemicals in our bodies: Biomonitoring Studies

• 100s of chemical contaminants in our bodies
• 216 linked to mammary tumors (Rudel et al., 2007)
• 1000s more untested
Environmental chemicals in our bodies: Biomonitoring Studies

- Chemicals found in adults & children
- Also
  - Amniotic fluid
  - Cord blood
  - Newborns
  - Breast milk

SO WHAT????
Environmental chemicals (EDCs) in our bodies: Links with breast cancer

SOME
• Personal care products
• Plastics and plastic additives
• Pesticides and herbicides
• Industrial chemicals
• Metals
• Detergents and other cleaning products
• Hormone supplements
• Radiation (including medical radiation)
EDCs & Health Problems

- Breast cancer
- Other cancers
  - Prostate, bladder, childhood leukemia, liver, stomach, brain, lung, thyroid, lymphoma
- Reproductive dysfunctions
  - Reduced fertility, low sperm counts
  - Early puberty, menstrual disorders
- Immune suppression
- Diabetes and other metabolic disorders
- Cardiovascular disease
- Learning disabilities and autism
- Parkinson’s and other neurodegenerative diseases
Caveats Important in Talking About Breast Cancer (or most cancers)

Breast cancer

• Not a singular disease
  • Age
  • Menopausal status
  • Histopathology profile

• Risk factors intersect
  • Personal, social, community, ethnic factors
EDC Framework: Key themes

Timing of exposures

Low doses

Mixtures

Interactions
Low doses matter

- EDCs & Non-monotonic dose-response curves
- Lower doses have bigger effects
Real life exposure mixtures interact

- Additively \((1+1=2)\)
- Synergistically \((1+1=5)\)
- Cancel one another out \((1+[-1]=0)\)
Interactions

- Gene x environmental chemicals
- Reproductive history x environmental chemicals
- Lifestyle x environmental chemicals
- Timing of exposure X dose
Timing of exposures

- Neonatal
- Early childhood
- Puberty, adolescence and early adulthood
- Pregnancy
- Lactation (mother and child)
- Post-menopausal
Timing of exposures

Adolescence

Young Adulthood

Pregnancy
Timing matters:
Structure of the mammary gland during the different life stages of the mouse, rat, and human & potential windows of susceptibility.
Relative time spent in the different stages of mammary gland development for mice, rats, and humans.
An example: **Diethylstilbestrol (DES)**

1938: DES first synthesized

![Chemical structures of Estradiol and DES](image)

1940-1971: Prescribed to pregnant women
  - Prevent miscarriage
  - Prevent premature labor

Endocrine disruptor, epigenetic effects
An example: Diethylstilbestrol (DES)

Women who took DES during pregnancy:
  • Clear cell adenocarcinoma
  • Breast cancer (after age 40)

Daughters of women who took DES during pregnancy:
  • Clear cell adenocarcinoma
  • Breast cancer
  • Fertility problems

Granddaughters of women who took DES during pregnancy:
  • (Breast cancer)
BPA and negative health outcomes: Laboratory studies

Low doses of BPA \( \rightarrow \) pregnant rats in their diet

- Increased mothers’ risk for developing mammary tumors.
- Increased daughters’ risk for developing mammary tumors as adults.

Effect on daughters found when mothers were fed BPA

- Just during pregnancy.
- Just during lactation.
DDT: Age of exposure and breast cancer risk
(Cohn, 2011)
Timing of Alcohol Consumption and Risk of Breast Cancer

(Liu, 2013)

- between menarche and 1st pregnancy
- after first full-term pregnancy

![Bar chart showing the risk of breast cancer for different timing of alcohol consumption.](chart)

- none: 1.08, moderate: 1.09, more: 1.11, heavy: 1.17
Goal: Live well. Avoid EDCs When Possible

A typical (very busy!!) day....
Concerns & Some Simple Tips
Personal care products

Think Dirty app
Skin Deep Database
Plastic bottles & toys

NO

YES

BE CAREFUL
House cleaning

TRY NOT

MUCH BETTER
Minimize frequency & dose

Maximize protection
AVOID

Lawn & garden

PLAN & PLANT for PEST CONTROL
HAVE FUN, but BE CAREFUL

CHECK INGREDIENTS

Sun screen NO

CHECK INGREDIENTS
SIMPLE SOAP and WATER
(AVOID TRICLOSAN)
Food shopping

Fresh, pesticide-free

Frozen

NO

Free range, no growth hormones
Thermal receipts

MINIMIZE CONTACT
Relaxing

Patch, slipcover, dispose of old furniture with exposed foam
SLEEP IN THE DARK
Learn More

- Everyday tips and resources
- Science behind tips
- Legislative action to make our products & our environment safer
- Market-based initiatives

www.breastcancerfund.org
www.safecosmetics.org
www.facebook.com/breastcancerfund

Prevention Starts HERE