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

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General Risks Factors Associated with Cancer

• Genetic profile (primary genes, polygenic variations, etc.)

• Lifestyle (diet, exercise, alcohol, tobacco, etc.)

• Reproductive history (age of menarche, menopause, pregnancy, breast-feeding, HRT, etc.)
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

- ~ 87,000 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 bodies: Biomonitoring Studies

- 100s of chemical contaminants in our bodies
- 216 linked to mammary tumors \( (Rudel \text{ et al.}, 2007) \)
- 1000s more untested

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)
“Research on the effects of EDCs on breast development and associations with mammary cancer has increased over the past few years, with both epidemiological and rodent studies supporting such links ... Among the EDCs with the strongest associations to impaired mammary development are dioxins, pesticides such as DDT and DDE, BPA, phthalates, and PFOA.”

Endocrine Society’s Second Scientific Statement on Endocrine Disrupting Chemicals, Executive Summary Released Sept 29, 2015
EDC Framework: Key themes

- Timing of exposures
- Low doses
- Mixtures
- Interactions
Timing of exposures

- Neonatal
- Early childhood
- Puberty, adolescence and early adulthood
- Pregnancy
- Lactation (mother and child)
- Post-menopausal
Low doses matter

- EDCs & Non monotonic dose-response curves

- Lower doses can have bigger effects
Mixtures

Real life exposure mixtures interact

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

- Gene x environmental chemicals
- Reproductive history x environmental chemicals
- Lifestyle x environmental chemicals
- \textit{Timing of exposure X dose}
- Etc.
An example: **Diethylstilbestrol (DES)**

1938: DES first synthesized

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

Endocrine disruptor, epigenetic effects

*Only exposure of fetuses: in utero*
An example: **Diethylstilbestrol (DES)**

**Mothers** who took DES during pregnancy:
- 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)
EDCs & Plastics

**Alkylphenols:** antioxidant stabilizers, surfactants

**Phthalates:** Plastic softeners, cosmetics additives

**Polyvinylchloride (PVC):** food packaging, credit cards, toys, building materials, etc

**Bisphenol A (BPA)**
1938: BPA shown to mimic estrogen

2001: BPA found in 95% of U.S. adult human urine samples

Also: Amniotic fluid, fetal blood, newborns, milk
BPA and negative health outcomes: Clinical/human studies

- Multiple miscarriages
- Sexual dysfunction and sperm damage in men
- Cardiac disease
- Diabetes and metabolic disorders
- Lung dysfunction & respiratory problems
- Oxidative stress and inflammatory response
- Prenatal testicular dysfunction
- Increased aggression & hyperactivity in toddler-aging girls
BPA and negative health outcomes: Laboratory studies

- Reproductive track abnormalities
- Diabetes and metabolic disorders
- Altered immune response
- Altered respiratory function
- Disruption of brain development
- Increased aggressiveness and altered play behavior
- Increased prostate and breast cancers
BPA and DES: many similar effects

Prenatal exposure $\rightarrow$ similar changes in mammary:

- Gene expression
- Cellular responses
- Milk production and content (in adulthood)
- Tumor development (in adulthood)
- Transgenerational increase in mammary tumors
Political and economic questions:

Burden of ‘proof’

- Jobs
- Used for 80 years, must be ok
- Environmental scare-mongering
- Economics and lobbying efforts
- Yes … perspective matters
“Cure” may be worse than problem:

- bisphenol S
- bisphenol F
Prevention

• Primary vs. secondary prevention

• Goal: cure for cancer (yes) or prevention of cancer (even better, when possible)?
Goal: Live well. Avoid EDCs When Possible

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

- Personal care products
- Cooking
- Plastic bottles & toys
- House cleaning
- Medical X-rays
- Lawn & garden
- Sun screen
- Hand washing
- Food shopping
- Thermal receipts
- Relaxing

- Light-at-night
Personal care products

Think Dirty app
Skin Deep Database
Cooking

NO

YES
Plastic bottles & toys

NO

BE CAREFUL

YES

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The image educates about the importance of choosing reusable options over plastic bottles and toys to promote environmental sustainability.
House cleaning

TRY NOT

MUCH BETTER

[Images of cleaning supplies]
Minimize frequency & dose
Maximize protection
AVOID

Lawn & garden

PLAN & PLANT for PEST CONTROL
NO

CHECK INGREDIENTS

HAVE FUN, but BE CAREFUL
Hand washing

SIMPLE SOAP and WATER
(AVOID TRICLOSAN)
Food shopping

NO

Fresh, pesticide-free

Frozen

Free range, no growth hormones
Thermal receipts

MINIMIZE CONTACT
Relaxing

Patch, slipcover, dispose of old furniture with exposed foam
Light at night

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
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