Health Effects of Chemical Exposures During Pregnancy and Early Childhood

Preventing HealthCARE from Becoming HealthHARM
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Objectives

After this talk, you will:

- Understand why children have higher *exposures* to toxic chemicals

- Understand why children and fetuses are more *vulnerable* to the health effects of toxic chemicals

- Understand the ways in which commonly used products such as cleaners, sanitizers and disinfectants can pose health risks to the fetus and young child.

- Know how to choose safer products that pose fewer health risks to these vulnerable populations as well as to the environment.
Why single out the fetus and the young child?

- The fetus and the young child are particularly vulnerable to the health effects of toxic exposures.

- Early life exposures to toxic chemicals are important causes of disease and dysfunction in children and also in adults.

- Diseases caused by chemical exposures can be successfully prevented.

- The fetus and the child are dependent on us for protection.
Understanding Children’s Environmental Health Risks: A Recent Science

- Until relatively recently, children were thought of as just “little adults” when it came to chemical exposures, and government regulation reflects this view.

- Our realization of children’s increased risk from environmental toxicants was set in motion by the publication of the groundbreaking report, *Pesticides in the Diets of Infants and Children*, by the National Academies in 1993.
Why single out the fetus and the young child?

- Children exposed to the same dose of environmental toxins and/or chemicals have proportionately much greater exposure compared to adults.
Why single out the fetus and the young child?

Young children have higher exposures because they:

• Eat, drink, and breathe more per kg
• These differences result in children being disproportionately exposed to toxic chemicals in air, food, and water.
Why single out the fetus and the young child?

Young children have higher exposures because they

• Have frequent contact with the ground
• Have a lot of hand-to-mouth activity
• Have a less varied diet
• Spend most of their time indoors
• Spend most of their time closer to the floor where heavier toxics settle in air and accumulate in dust.
Why single out the fetus and the young child?

Young children are more vulnerable because they:
• have immature metabolic systems.
  • Their metabolic pathways are not fully developed.
• are developmentally immature—their organs are still developing and vulnerable.
Why single out the fetus and the young child?

- Developmental processes in the fetus and the young child are easily disrupted
  - These developmental processes are rapid, complex and highly choreographed.
Why single out the fetus and the young child?

- Recent research suggests that there are “windows of vulnerability” in the development of the fetus and the child.

- These windows have no equivalent in adult life.

- During these critical periods, very small amounts of toxic chemicals can have profound effects on organ formation, amounts that would have no effect on an adult.
Why single out the fetus and the young child?

- Finally, exposure to toxic chemicals can lead to disease decades later.

- The fetus and young child have many decades of life ahead during which these diseases can develop.

- Some chemical exposures we experience are now known to affect the offspring of our offspring.
Why single out the fetus and the young child?

- Many childhood conditions are now known to be related to environmental exposures
  - Asthma
  - Neurodevelopmental disorders
    - ADHD
    - Autism
    - Cancer
ADHD is increasing

Percentage of children ages 5 to 17 years reported to have attention-deficit/hyperactivity disorder, by sex, 1997-2010

Data: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey

America's Children and the Environment, Third Edition
Autism is increasing

Percentage of children ages 5 to 17 years reported to have autism, 1997-2010

Data: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey, America’s Children and the Environment, Third Edition
While there are things that we can, and should, do as individuals and institutions to protect the fetus and young child, the problem is too pervasive and hidden for anyone individual or institution to comprehensively protect children.

There have been 80,000 new chemicals introduced into our environment in the past 50 years, all but a handful untested for health effects.
The problem requires government regulation. TSCA, The Toxics Substances Control Act, has not been updated since 1976. A Supreme Court decision in 1991 has made it essentially impossible for the Environmental Protection Agency to regulate dangerous chemicals under the act.

TSCA reform is essential for protecting the health of our children, including a legally mandated requirement that chemicals already on the market be systematically examined for potential toxicity.
Example: Cleaning and Disinfecting Products

- Products used to clean, sanitize and disinfect our homes, schools and hospitals are a good example of the pervasive and unregulated use of toxic chemicals that put the health of our children at risk.
Cleaning, Sanitizing and Disinfecting Products

- These products are used in our homes, schools and workplaces constantly.

- Many people are unaware of the health risks posed by these products.

- If they are aware of the health risks, they often do not know how to choose or use safer products.
Most cleaning, sanitizing or disinfection products sold are not safe, even though they are available at most stores.

Only the chemicals that kill bacteria, viruses, or mold (disinfectants) have to be labeled.

Manufacturers are not required to list all the ingredients on the label.

Many cleaning and sanitizing chemicals can cause health problems in children and workers.
What is the Difference Between Cleaning, Sanitizing and Disinfecting?

• Before choosing any type of cleaning or antimicrobial product, you will first need to decide whether the surface needs to be:

Cleaned
Sanitized
or
Disinfected
Cleaning

• Uses a detergent and water to physically remove dirt, grime and germs from surfaces. **This process does not necessarily kill germs.**
• Removes molds and allergens that can trigger asthma symptoms.

Has been found to remove as much as 99% of germs when microfiber cleaning tools are used.
Sanitizing

• **Reduces** the number of germs on hard surfaces or objects to a safer level - at least 99.9%.
• For food surfaces the level should be a 99.999% reduction in microorganisms within 30 seconds.
• Sanitizing products should state on their label the surfaces they are intended to be used on.

Sanitizers are used on food preparation and contact surfaces, and mouthed toys and pacifiers.
Disinfecting

• **Inactivates** 99.999% of germs on surfaces or objects if allowed to sit visibly wet or “dwell” on the surface for the recommended amount of “dwell” time.
• For use on:
  - changing tables
  - bathroom sinks and toilets
  - high risk areas that collect lots of germs, such as doorknobs, cabinet handles and drinking fountains.

A disinfectant must stay on the surface for at least the recommended dwell time or it will not ‘kill’ all of the germs. This may lead to the creation of “super bugs”.
Why Can’t We Just Use a Disinfectant/Cleaner Everywhere?

• Disinfectants don’t necessarily clean surfaces. Germs can hide under dirt and grime and are not affected by them.

• The products used to disinfect are more toxic and usually more expensive than products used to just clean.

• Overusing antimicrobial products may also lead to the spread of "super bugs."
What’s the Problem with Bleach?

- **Bleach:**
  - can cause asthma
  - triggers asthma episodes
  - can affect breathing
  - can irritate the skin and eyes
  - was the source of 35,000 poisonings in 2011

- Children are at greater risk from breathing bleach vapors because their lungs are still developing.

- In a recent study of 9102 children in Finland and Spain, the prevalence of infections was *higher* among children of bleach users.

What's the Problem with Bleach?

- Mixing bleach with other chemicals containing ammonia, quaternary ammonium compounds (found in other disinfectants), vinegar or other acids can create a toxic gas.

- Bleach corrodes many metals. It should never be used on stainless steel, aluminum, copper, brass, marble, or granite.

- Bleach is neutralized by dirt and other organic material, so it isn’t very effective when used on a surface that hasn’t been cleaned.
Asthma and Asthmagens

Many cleaning, sanitizing, and disinfecting products can irritate the lungs, and trigger or even cause asthma.

Asthma is a chronic inflammatory disorder of the airways in the lungs that results in:

- Wheezing
- Coughing
- Chest tightness
- Trouble breathing
Asthma and Asthmagens

Asthma Triggers: Once a person has asthma, exposure to “triggers” can cause an episode of asthma.

These triggers include:
- Household dust and dust mites
- Pets
- Cockroaches
- Mold
- Cigarettes
- Cleaning, sanitizing and disinfecting products
Examples of Safer Products

Disinfectants

Ready-To-Use (RTU)
- Clorox Green Works 30 second – 1 minute dwell time
- OxivirTb - 1 minute dwell time
- Clean-Cide - 5 minute dwell time

Concentrate
- Oxivir Five 16 - 5 minute dwell time
Ingredients To Avoid: Asthmagens or Asthma Triggers

Benzalkonium Chloride

Bisphenol A (BPA)

Bleach

Ethanolamines
- monoethanolamine [MEA]
- diethanolamine [DEA]
- triethanolamine [TEA])

Fragrance Ingredients

Parabens and Phthalates

Quaternary ammonium compounds: alkyl dimethyl benzyl ammonium chloride (ADBAC), benzalkonium chloride, and didecyl dimethyl benzyl ammonium.

Volatile Organic Compounds – found in aerosol products etc.
When dealing with toxic chemicals, the bigger the dose, the worse the effects on children and fetuses.

- True
- False
Endocrine Disrupting Chemicals (EDCs)

• Endocrine Disruptors are chemicals that interrupt or imitate natural hormonal messages.

• Since hormones work at very small doses, endocrine disrupting chemicals can also affect health in very small amounts.

Very small doses of EDC’s can harm people in different ways, essentially tricking the body into responding to chemicals as hormones during key stages of development.
Endocrine Disrupting Chemicals (EDCs)

- May cause:
  - reduced fertility in women and men
  - early puberty in girls
  - increases in cancers of the breast, ovaries, and prostate.
Endocrine Disrupting Chemicals (EDCs)

- The field of toxicology has generally accepted that the response of an organism to a toxicant increases proportionally with the dose (known as a monotonic dose–response).
Endocrine Disrupting Chemicals (EDCs)

- But, not all responses between dose and response are linear, especially for the fetus and the young child.

- Studies of EDCs have challenged this traditional concept that “the dose makes the poison,” because EDCs can have effects at low doses that are not predicted by effects at higher doses (“non-monotonic” dose response).
Many cleaning, sanitizing and disinfecting products contain the germ-killing chemicals triclosan and its relative, triclocarbon.

These active ingredients act to slow or stop the growth of bacteria, fungi, and mildew.

They are found in antibacterial soaps, deodorants, sponges and household cleaners and disinfectants.

Triclosan ends up in our drains, sewage systems and, eventually, our waterways and agricultural fields. Over 400,000 pounds, to be exact.

Much of the triclosan we flush, wash away, and dispose of in other ways ends up in the soil, where it may be absorbed by growing fruits and vegetables.
Triclosan

- Collects in human and animal tissue, including in the umbilical cord blood of infants and in the breast milk of nursing mothers.
- Can interfere with thyroid function (endocrine disruption).
- Can cause skin irritation.
- In recent studies, when researchers exposed fish and mice to triclosan, their skeletal and heart muscles didn’t contract normally.
Endocrine Disrupting Effects of Triclosan

- **Thyroid---blocking**
  - Alters metabolism & transport of thyroid hormone

- **Estrogen---enhancing**
  - Synergizes estrogen action

- **Testosterone---blocking**
  - Decreases testosterone & sperm production
What are Phthalates and BPA?

- Phthalates and BPA are man-made chemicals called endocrine disruptors.
- Phthalates and bisphenol A (BPA) are used for a variety of purposes in plastics, cleaning and personal care products.
- They can affect hormones such as estrogen and testosterone, which are important for the reproductive system.
- They can potentially interfere with normal growth and brain development.
Phthalates can be found 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 especially high in phthalates.
- Cleaning products and air fresheners.
- Personal care products (i.e. shampoos, lotions, makeup, perfume).
- PVC building materials and dust generated from these materials.
- Plastic medical devices (i.e. IV tubing, IV fluid/total parenteral nutrition bags, catheters).
- Some time–released medications.
How are children and pregnant women exposed to BPA and phthalates?

- Phthalates and BPA can be eaten (ingested), breathed in (inhaled), and absorbed through the skin.

- Children can have higher intakes of these chemicals compared to adults because of their unique behaviors (such as putting things in their mouths and breathing faster than adults).
Phthalates can affect hormone (testosterone) concentrations and growth/development:

- In studies using animals, phthalate exposure when the fetus is developing can increase the risk of:
  - Problems with male reproductive organs
  - Decreased birth weight

- In humans, scientists have observed that phthalate exposures may place the developing fetus at increased risk for:
  - Changes in male reproductive organs, like hypospadias (positional change of the opening on the penis)
BPA exposure during fetal life may increase the risk for:

- Behavior issues (like hyperactivity and aggression)
- Later breast development during puberty
- Obesity and diabetes
- Heart disease
- Changes in liver function

In May, California officially placed BPA on its list of chemicals known to cause reproductive harm (California's "Proposition 65" list).
To reduce exposure to BPA and phthalates

- 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.
- Buy fresh or frozen fruits and vegetables when possible. Avoid canned and processed foods.
- When possible, purchase items that are phthalate free or BPA free, but keep in mind that BPA substitute chemicals have been found to be as problematic as BPA.
- Minimize personal care product use. Keep it simple, less is more. Choose products identified by the Environmental Working Group as safer in their Skin Deep database [http://www.ewg.org/skindeep/](http://www.ewg.org/skindeep/)
- Use glass, stainless steel, ceramic, or wood to hold and store foods instead of plastics.
- Do not microwave food/beverages in plastic.
- If using hard polycarbonate plastics (some water bottles/baby bottles/sippy cups), do not use for hot liquids.
- If plastics cannot be avoided, 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). Hand wash instead of putting in the dishwasher–heat releases the chemicals.
- Encourage frequent handwashing.
- Minimize handling of receipts and wash your hands before eating.
- Take shoes off at home to avoid tracking in dust that may contain these chemicals.
- Keep carpets/windowsills clean – vacuum and wet dust frequently to minimize accumulation of dust that may contain these chemicals.
Fragrances

Fragrances are found in most cleaning, sanitizing and disinfecting products, and contain chemicals called volatile organic compounds (VOCs). They also contain phthalates.

VOC’s impact both indoor and outdoor air quality, as well as the water supply.

Like Triclosan, VOCs are not filtered out by water treatment, which results in contamination of our lakes, rivers and bays.

In fact, nearly all shellfish and fish in the United States now have measurable levels of fragrances in their tissues!
Fragrances and Human Health

- Even ‘unscented’ or ‘fragrance-free’ products may actually contain fragrances which are added to mask the smell of the chemicals in the product.

- The chemicals contained in these fragranced products may enter the body in many ways. They are:
  - Absorbed through the skin
  - Swallowed
  - Inhaled into the lungs
Fragrances and Human Health

What You Can Do About It:

• Consider using fragrance-free, non-chlorine bleaches containing hydrogen peroxide instead of those that are scented.

• Choose unscented cleaning products that have been certified by third party organizations such as Green Seal, EcoLogo or Design for the Environment.
The words “natural,” “nontoxic,” and “green” that appear on product labels are unregulated by the government.

Researchers have found that products labeled “green” often have as many toxic chemicals as conventional cleaning products.

Cleaning products do not have to list ingredients on the label and manufacturers do not have to prove that they are safe before they market them.

These gaps in ingredient information on product labels make it difficult for the consumer to make wise choices when purchasing cleaning products.
Identifying Safer Products

Third-party certified cleaning products:
- Green Seal
- EcoLogo
- Design for the Environment

Design for the Environment pilot disinfectant project
Institutional Cleaning Products

- Purchased from a cleaning products distributor.
- Often not available in retail stores.
- Available as a concentrate.
- Accompanied by safety data sheets (SDS)*.
- Generally less expensive.

It is easier to find institutional products that are certified as safer by a third-party (Green Seal, EcoLogo or Design for the Environment)
Retail Products

- Purchased at a retail store like a grocery store.
- Available in ready-to-use containers.
- Less likely to be certified as safer by a third-party (Green Seal, EcoLogo or Design for the Environment).
- Do not come with OSHA-required Safety Data Sheets.

Retail Products are often more expensive and not labeled as completely as institutional products.
Choosing Safer Cleaning Products

- Look for the Following:
  - Products that are third-party certified.
  - The signal word **Warning rather than Danger** on the label.
  - Non-aerosol.
  - Fragrance-free and dye-free.
  - All ingredients listed on the label or a website.
  - No overwhelming chemical odor.
Choosing Safer Disinfectants

- Look for the Following:
  1. EPA registration number.
  2. 0 rating on the Hazardous Materials Identification System (HMIS) health rating scale.
  3. The signal word **Caution** or **Warning** rather than **Danger** on the product label.
  4. Hospital-grade classification (this is a requirement of child care licensing agencies in most states).
  5. Short dwell time or the time the disinfectant must be left visibly wet on the surface.
Dry steam vapor technology:

• Very effective for cleaning and rapid sanitizing/disinfecting.
• Approved for most surfaces, including food contact surfaces.
• Unfortunately, still very expensive.
Microfiber Cloths and Mops

GREAT alternative to normal cotton rags or paper towels!

• Remove organic matter (dirt, oils, grease) as well as germs (up to 99%) from surfaces.

• Washable 500-1,000 times.

• Reduce landfill waste.

• Work well with green cleaning products/need less cleaning detergent to be effective.
Disinfectants Recommended by the City of SF Toxics Reduction Program

Hydrogen Peroxide Products:
- Accel (Concentrate: 1:128, 3-minute dwell time)
- Alpha HP (Concentrate, 1:128 dilution, 3-minute dwell time)
- Alpha-HP Multi-Surface Disinfectant Cleaner (Concentrate, 1:128 dilution, 3-minute dwell time)
- Carpe Diem Concentrate Five 16 (Concentrate: 1:128, 3-minute dwell time)
- Envirox Concentrate 118/H2Orange2 117* (Concentrate, 5-minute dwell time)
Disinfectants Recommended by the City of San Francisco’s Toxics Reduction Program

Hydrogen Peroxide (cont’d)
- Envirox H2Orange2 Superconcentrate 112 (Concentrate: 5:23 dilution, 5-minute dwell time)
- G-Force H2O2 Bathroom Cleaner Disinfectant (Concentrate, 1:128 dilution, 3-minute dwell time)
- Oxivir Five 16 (Concentrate, 1:128 dilution, 3-minute dwell time)
- Ramsey Bathroom Cleaner Disinfectant (Concentrate, 1:128 dilution, 3-minute dwell time).
Disinfectants Recommended by the City of San Francisco’s Toxics Reduction Program

Citric Acid Products
- Comet Disinfecting Bathroom Cleaner (Concentrate, 1:4 dilution, 5-minute dwell time)

Caprylic/Octanoic Acid Products
- Ecolab 65 Disinfecting Heavy-Duty Acid Bathroom Cleaner (Concentrate, 1:40 dilution, 5-minute dwell time)

All of these are concentrates that have to be diluted. Remember: ready to use products are 15 times more expensive, and take much more energy to transport.
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