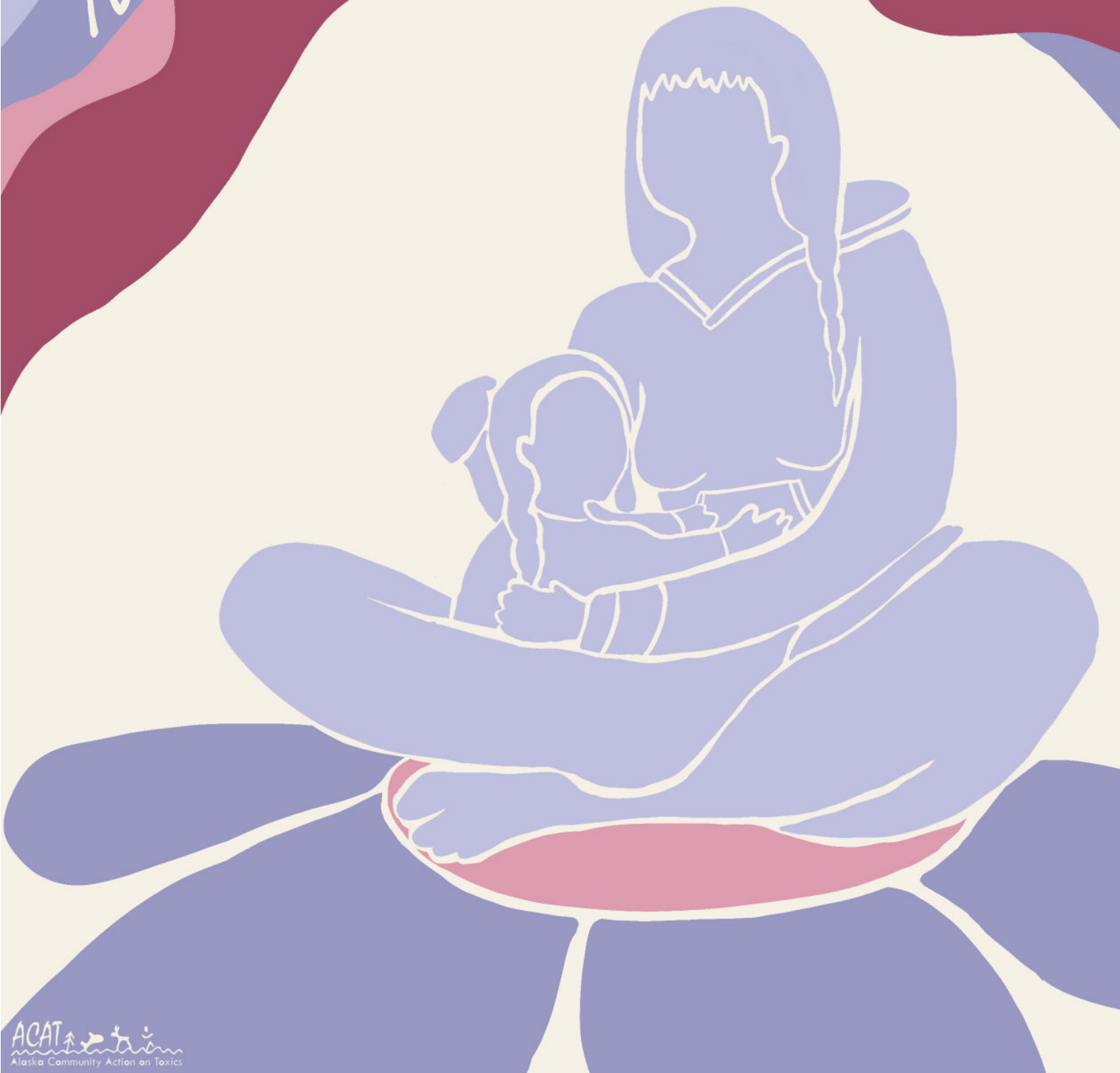


PROTECTING OUR MAMAQS
TO PROTECT OUR FUTURE GENERATIONS



PROTECTING OUR MAMAQS & OUR HEALTH :

**An Environmental Health Toolkit for Breast Cancer Prevention
& Protecting the Health of People Living with Breast Cancer**

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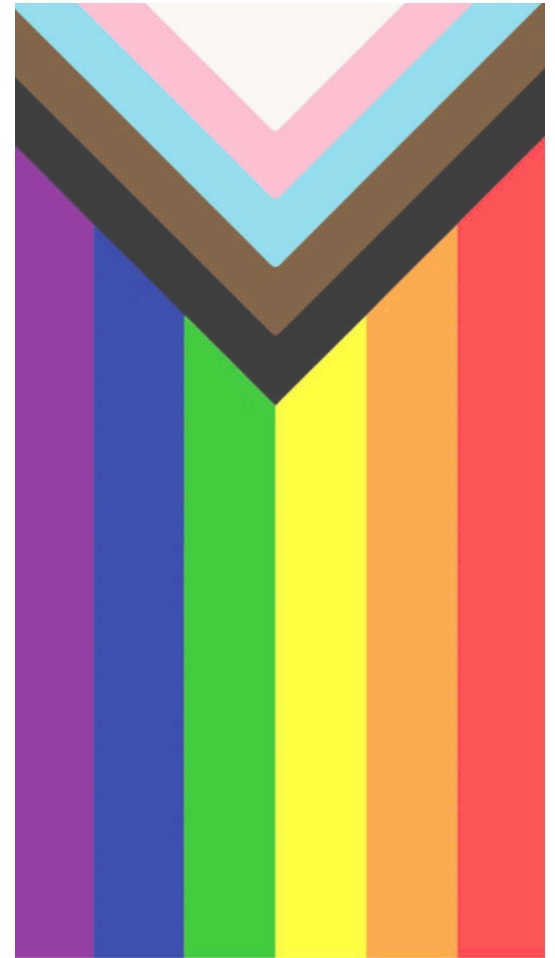
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GENDER INCLUSIVITY STATEMENT

ACAT recognizes that people of different gender identities can be at risk of breast cancer. Furthermore, transgender, queer, non-binary, and two-spirit people may face discrimination and a lack of access to gender affirming breast cancer information, screening and care.

ACAT advocates for an approach to breast cancer research, awareness and resource access that is gender inclusive. Breast cancer research is needed that includes the experiences and investigates the risk factors of people of diverse gender identities and for those who may or may not have undergone gender affirming care. Making breast cancer healthcare inclusive of, and accessible to, people of marginalized gender identities is incredibly important.

Throughout this toolkit we have attempted to be mindful of our gendered language. In this toolkit we use the term “people(s)” when addressing broad statements about breast cancer and we use the gendered term “women” in statements based on information gathered from studies performed with women participants, and most do not specify other gender identities. Gender inclusivity in ACAT’s breast cancer prevention work is an ongoing goal of the organization, and we welcome suggestions as to how we might improve.



ACKNOWLEDGEMENTS



GROUNDSWELL
FUND



CEDAR
TREE
FOUNDATION



Alaska Run for Women
Fighting Breast Cancer Since 1993

This project is a part of Alaska Community Action on Toxics' Breast Cancer Prevention program. The goal of this program is to decrease the risk of breast cancer among Alaska Native women by raising awareness of environmental risk factors and precautionary measures.

We are grateful for the funding support and encouragement for this project provided by the [Alaska Run for Women](#), the [Cedar Tree Foundation](#), [Groundswell Fund](#), as well as individual donors. Thank You!



“We as women and especially Women of Color deserve better.

We see the highest mortality rates of breast cancer in Black women and Latinas. These chemicals are harming our reproductive health, with many of the effects being passed on to future generations as we see our children born pre-polluted.

“Education and prevention are the keys to winning this fight.

But more importantly, we need our government to step up and provide justice by holding chemical corporations accountable with common sense regulations for testing the safety of chemicals added to products that millions of women and girls use.

“To women who read this, we invite you to use your voice and tell your story. Demand that these companies stop polluting our bodies and putting our children at risk. We demand environmental justice because we are the women of the Earth, the child bearers, the caregivers and our children’s first environment.”

*Samarys Seguinot-Medina, DrPH, MSEM, Boricua living in Alaska,
Environmental Health Director, Alaska Community Action on Toxics*

Excerpt from Opinion Editorial:

“[Breast cancer, chemicals and environmental justice.](#)”

Juneau Empire, 1 July 2020



HONORING ANNIE ALOWA

With this publication, *Protecting Our Mamaqs: An Environmental Health Toolkit for Breast Cancer Prevention*, we would like to honor Annie Alowa and begin with her story.

Annie Alowa was a Community Health Aide and respected elder from Savoonga, Alaska on Sivuqaq (St. Lawrence Island). During her lifetime, Alowa served as a midwife, community health aide, and advocate for health and justice.

In 1952, the U.S. Air Force established a base at Northeast Cape on Sivuqaq. When the site was vacated in 1972, the military left behind an extraordinary amount of hazardous material in landfills, including massive amounts of oil and fuel, paint, batteries, and metal garbage. Later, Annie learned of other hazardous materials buried at the site, including asbestos, PCBs, pesticides, solvents, lead-based paint, fuel tanks, and barrels full of lubricants and fuel.

Annie began to notice serious health problems among Island residents who lived, worked, and

harvested marine mammals, greens, berries, fish, and reindeer from the Northeast Cape area. For the first time, she began to see cancer among her people, as well as significant increases in low birth-weight babies and miscarriages. She noticed changes in the land and wildlife and realized these conditions may be associated with contaminants from the military site.

Annie became concerned that these hazardous materials posed a long-term health risk for island residents and began to address these concerns with the Alaska delegation. For two decades, she attempted to get the military to clean up Northeast Cape, but she was repeatedly sent from one state and federal agency to another without a hearing. Eventually Annie met Pamela Miller in the spring of 1997 at a Greenpeace-sponsored environmental health conference. That summer, Greenpeace flew her and Pam to Northeast Cape to examine the abandoned military site and to take environmental samples and photographs. In 1998, after Pam founded Alaska Community

Action on Toxics (ACAT), she and Annie met with a colonel of the Army Corps of Engineers to urge him to clean up the toxic waste at Northeast Cape. Seventy-three-year-old Annie spoke quietly but eloquently about the thirteen people in her village who died of cancer in the past few years, all of whom had lived and gathered wild foods from the Northeast Cape area. The colonel dismissed her concerns and stated that St. Lawrence Island was low on the list for cleanup. Before Annie returned home to Savoonga, she and Miller discussed strategies to get the abandoned site cleaned up.



Following Annie’s efforts to raise attention and awareness, the Northeast Cape site went from near the bottom of the priorities list for cleanup to the top. Although there is much yet to be done to restore the lands and waters at Northeast Cape, the Army Corps of Engineers has spent \$123 million on the cleanup thus far¹ – the most expensive cleanup ever done at a formerly used military site in Alaska.² This would not have been done without Annie’s work.

Later that year, Annie was diagnosed with liver cancer, while her previously diagnosed breast cancer was still in remission. She asked Pam to interview her to tell her story and share her concerns. She asked again that the agencies come to Northeast Cape and clean it up, and advised that her people and agency officials should avoid conflict and work together to make things right. Even when she knew she was dying, Annie never gave up trying to get help for her community. During the interview, she said to Pam, “I will fight until I melt.”

In spring 1999, ACAT produced a video of Annie’s interview entitled, [*I Will Fight Until I Melt \(Whanga Pillugaghleqaqa Kenlanga Ughullemnun\)*](#). This short film demonstrates Annie’s concerns, and presents a call for others to respond to her observations about the impact of military toxics on the health of her people.

Annie Alowa was inducted into the Alaska Women’s Hall of Fame in 2016 due to her extensive and influential commitment to the environment and health of Sivuqaq and her people. Annie’s spiritual faith, perseverance and hope even in the face of overwhelming odds served as a catalyst for her community, along with Pam and ACAT, to move to protect the people of Sivuqaq and other Alaska Native communities from the effects of environmental contaminants.

Many people are encouraged by her work and continue to strive for justice and human rights to further her legacy. Annie continues to serve as an impetus for action, both during unrelenting challenges and through joyful successes, as her spirit lives on in people’s hearts.

Excerpted from the Alaska Women’s Hall of Fame, Class of 2016.
For Annie Alowa’s full biography, please visit:
<https://www.alaskawomenshalloffame.org/alumnae/annie-alowa/>

WHO WE ARE

Alaska Community Action on Toxics (ACAT) is an environmental health and justice organization that helps Alaskans concerned about the impacts of toxic chemicals on their families' health. Our mission is, "We believe everyone has a right to clean air, clean water, and toxic-free food. Driven by a core belief in environmental justice, ACAT empowers communities to eliminate exposure to toxics through collaborative research, shared science, education, organizing, and advocacy." ACAT's work is based on science, the precautionary principle and prevention of harm before it occurs.

A main focus of ACAT's work has been to address Annie Alowa's concerns about the long-term harm caused by the military and other sources of contaminants on the health of Sivuqaq's Yupik People. This work has led to a broadening of concern about other Alaska communities troubled by harmful exposure to toxic chemicals.



ACAT serves all of Alaska's residents and works with a broad diversity of people. Much of our work is conducted in collaboration with Alaska Native tribes and communities. Our board and staff reflect the diversity of the people we serve.

For 23 years, ACAT has worked with Alaska Native communities and tribal organizations concerned with harmful chemicals and has developed good working relationships with healthcare providers. This toolkit has been peer reviewed by current and former Community Health Aides, scientists, and other experts.



The **Alaska Community Health Aide Program (CHAP)** consists of a network of approximately 550 Community Health Aides/Practitioners (CHA/Ps) in over 170 rural Alaska villages. CHA/Ps work within the guidelines of the Alaska Community Health Aide Manual (CHAM) in assessing and providing emergent, acute and chronic care to residents of their respective communities. Alaska CHA/Ps are the front line of healthcare in their communities.

ENVIRONMENTAL HEALTH AND CONTAMINANTS IN ALASKA AND THE ARCTIC

Understanding the impact of environmental exposures on human health is a growing part of the field of public health. When considering preventable causes of disease, the primary focus is often on behavioral and lifestyle factors such as diet, smoking, alcohol use, exercise and exposure to ultraviolet (UV) light. However, exposures to chemical contaminants at work, home, outdoors, and even *in utero*, are now recognized as important, and reducing exposure can prevent human diseases and disabilities.

Toxic chemicals from many sources are showing up in Alaska lands, waters, fish and wildlife. Hundreds of abandoned military sites, waste sites full of chemicals, plastics, and electronics, and industrial pollutants from all over the world carried north to the Arctic by wind and ocean currents – all of these and more contribute to exposures that may harm human health. Communities in northern regions are disproportionately exposed to environmental chemicals from these sources, as well as from traditional foods contaminated by these chemicals.³ We now know that Arctic Indigenous Peoples are one of the most highly contaminated populations on the planet, due to their reliance on subsistence foods.⁴

ACAT believes that everyone has a right to know what contaminants are present in the air, water and soil in their environment, as well as in foods and household products. If toxic chemicals are present and known to be associated with health problems, we believe precautionary measures and ways to eliminate unnecessary exposure to those chemicals must be taken. Knowledge about these contaminants is the first step to reduce and prevent exposure.

TOOLKIT ON ENVIRONMENTAL LINKS TO BREAST CANCER AND PREVENTION

Protecting Our Mamasq: An Environmental Health Toolkit for Breast Cancer Prevention is designed to train Community Health Aides/Practitioners (CHA/Ps), other health care professionals, and the people of Alaska about environmental contaminants found in the North and Arctic regions that are linked to breast cancer. ACAT believes this is a fundamental right-to-know issue and offers this toolkit in the spirit of providing information to support people's ability to make their own informed decisions.

The toolkit includes facts about cancer-causing and hormone-disrupting chemicals that contaminate the traditional foods, air, water and land of Alaska Native peoples, as well as household and personal care items. It also explores the effects of these chemicals on human health, offers guidance on how to reduce exposure, and provides an environmental health assessment tool to help CHA/Ps identify patients' exposures.

Learning Objectives

After completing the training modules in this toolkit, Community Health Aides/Practitioners (CHA/Ps) and other tribal healthcare providers will have the information necessary to:

- Help Alaska Native women reduce their exposures to harmful chemicals that cause cancer and hormone disruption; and
- Discuss risk reduction with their patients as an important part of breast cancer prevention and care for those living with cancer.

After reading the toolkit, fact sheets and other related materials, Alaska Native women will have the information necessary to:

- Develop plans to reduce their exposures to harmful chemicals; and
- Encourage their friends and family to follow their lead to develop their own plans to reduce exposures to harmful chemicals.

The long-term goal of this project is a decline in the risk of breast cancer among Alaska Native women.



Photo by Sara Thomas

WORKING TOGETHER: COLLABORATION WITH THE ALASKA COMMUNITY HEALTH AIDE PROGRAM

This toolkit was developed by ACAT in partnership with the Alaska Community Health Aide Program (CHAP).

In the spirit of Annie Alowa, ACAT seeks to continue our collaboration with CHA/Ps about health hazards related to environmental exposures. Working together will allow us to cover more ground than we could on our own and, ultimately, make a difference to help improve health and wellbeing in the North/Arctic Region.

ACAT and CHAP have a history of working together on training programs concerning environmental links to health in the villages of Alaska. In this project, ACAT and CHAP will work together to help prevent breast cancer in Alaska and to protect the health of women and men diagnosed with breast cancer.

Supplemental materials from this project include fact sheets, maps, posters, articles, and other resources that CHA/Ps may display in clinics and distribute to patients. This toolkit and its supplemental materials will also be available publicly on ACAT's website, www.akaction.org. With assistance from our partners, these materials will be translated into key Alaska Native languages.



MODULE 1: BREAST CANCER AND ENVIRONMENTAL CHEMICALS

What Is Breast Cancer?

Breast cancer is a group of diseases that form in the breast tissue of women and men when cells change and grow uncontrolled, usually forming a lump or mass. Most breast cancers begin in the milk glands or in the milk ducts of the breast.⁵ Screening is very important for early detection, because breast cancer usually has no symptoms in the early stages. The most common sign is a painless lump or swelling in the breast or in the underarm lymph nodes.⁶

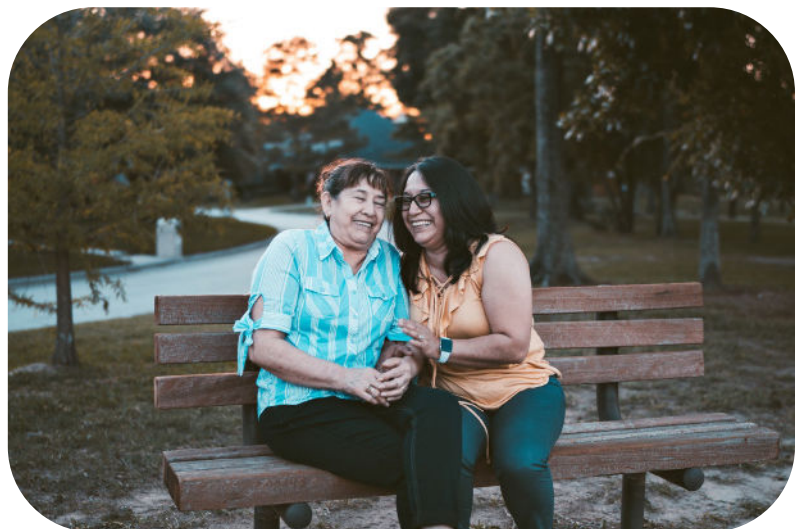
Breast cancer is the most common cancer and cause of cancer-related death among women worldwide.⁷ The American Cancer Society estimates 281,550 new cases of breast cancer in women in the United States in 2021, or about 30% of all new cancer cases in women, with deaths from breast cancer estimated to be about 16% of all cancer deaths.⁸ In Alaska alone, the estimates were 520 new female breast cancer cases in 2021, about 16% of estimated new cancer cases in the state.⁹ It is estimated that 1 in 8 women in the United States will be diagnosed with invasive breast cancer during their lifetime – a 40% increase since the 1970s.¹⁰

Breast cancer was once almost solely limited to postmenopausal women, but now also occurs in young women between the ages of 20 and 40¹¹ – especially young Black women – and is the second leading cause of cancer death in American women.¹²

Breast Cancer in Alaska

In Alaska, female breast cancer is the most common cancer diagnosed among Alaska Native women.¹³ Between 1974-1994, the incidence of breast cancer (diagnosis of new cases) increased by 105% among Alaska Native women.¹⁴ Since then, the incidence rates in Alaska Native women have stabilized and are similar to incidence among white women in the United States.¹⁵

However, significant disparities can still be found in the incidence of breast cancer among certain age groups and tribes, as well as in disease severity and mortality rates. Alaska Native women are more likely to be diagnosed with breast cancer at younger ages and later stages than white women in Alaska.^{16, 17} One study of data from the U.S. Centers for Disease Control and Prevention (CDC) found that the incidence rate for invasive breast cancer in women under the age of 40 years is 58% higher in Alaska Native women compared to non-Hispanic white women in the same region.¹⁸ In the same study, the percentage of women diagnosed with breast cancer under the age of 40 was twice as high



in American Indian and Alaska Native women than in non-Hispanic white women (8.5% vs 3.9%).³¹ Finally, while the mortality rate of breast cancer in white women decreased from 1990 to 2009, mortality has remained stable in American Indian and Alaska Native women.³²

Athabaskans and circumpolar Inuit especially have a significantly increased risk of breast cancer compared to the world average.³³ Regionally, one study found the highest rates of female breast cancer in the Aleutian and Pribilof, Copper River and Prince William Sound, Interior, and Southeast regions.³⁴ Alaska Native women aged 40-49 years are nearly twice as likely as white women of the same age range to die of breast cancer.³⁵

This evidence suggests that preventive measures need to be emphasized in communities of color, paired with more targeted screening and improved access to cancer care for American Indian and Alaska Native women to ensure that breast cancers are detected early and followed by timely, high-quality treatment.³⁶

What Causes Breast Cancer?

There is no single cause of breast cancer, but rather many risk factors that may influence a person's chances of getting the disease. Some risk factors are well-established as causes of breast cancer—such as ionizing radiation, tobacco smoke, alcohol consumption, and lack of physical activity. There is growing evidence of other risk factors suspected to be involved in development of the disease, such as environmental chemical exposures, exposure to light at night, and certain occupational exposures. Still other factors may have a protective effect against breast cancer, such as breastfeeding, certain diet and nutritional factors, and some types of chemical exposures.³⁷

While there is still more to learn about what causes breast cancer, there is sufficient evidence to take precautions now to support health and prevent disease. A 2013 report of a federal advisory committee, *Breast Cancer and the Environment: Prioritizing Prevention*, found that identifying and eliminating environmental causes of breast cancer is the best opportunity to reduce incidence of the

disease. The committee concluded, “Prevention is the key to reducing the burden of breast cancer.”¹⁹

This toolkit will focus on reducing risks from exposure to environmental chemicals.

Environmental Contaminants Linked to Breast Cancer

An increasing number of breast cancer cases cannot be explained simply by known risk factors, such as family history, age or reproductive history.²⁰ A growing body of evidence suggests that the environment around us plays a role. We are routinely exposed to innumerable chemicals every day and throughout our lives that may have adverse effects on our health.^{21, 22, 23, 24} Many people are not yet aware that industrial chemicals have been linked to a wide range of serious health effects including disrupted breast development, difficulty becoming pregnant, low birth weight, neurodevelopmental impairment, and harm to the endocrine system that can be linked to certain cancers.^{25, 26}

“Breast cancer in women under the age of 40 years is 58% higher in Alaska Native women compared to non-Hispanic white women in the same region.”

More than 350,000 chemicals worldwide are currently registered for production and use.²⁷ Of the greater than 85,000 chemicals registered in the United States,²⁸ less than 1% have ever been tested for safety and only nine have been restricted or banned.²⁹ The original federal law for regulating chemicals in the U.S., the Toxic Substances Control Act of 1976 (TSCA), presumed chemicals were safe until regulatory agencies could prove them harmful, rather than requiring the chemical industry to prove safety before these chemicals were used in everyday products. Under TSCA, the government was also unable to regulate even chemicals known to be hazardous – namely asbestos.³⁰

In 2016, the Frank R. Lautenberg Chemical Safety for the 21st Century Act was passed, which provided long overdue remedies to U.S. chemical policy and limits the use of unsafe chemicals linked to cancer, learning and developmental disabilities, reproductive harm, and other illnesses. The Lautenberg Chemical Safety Act made notable improvements to TSCA, strengthening the U.S. Environmental Protection Agency's authority to require chemical testing and to regulate chemicals based on health and environmental factors. It also includes explicit mandates to protect vulnerable populations, including children and pregnant women.³⁸ However, the new law is not without its own flaws, and whether it will truly safeguard present and future generations from toxic exposures depends on how it is implemented and enforced.

A growing number of chemicals found in the environment are now understood to be linked to breast cancer. A new study from the Silent Spring Institute has identified nearly 300 chemicals that can increase estrogen or progesterone levels in laboratory studies and are at least potential risk factors for breast cancer.³⁹ An earlier study showed that 216 chemicals have been shown to increase the presence of mammary gland tumors in animal studies, an indicator of carcinogenicity (the ability to cause cancer) in humans.⁴⁰

People come into contact with environmental chemicals in many aspects of our lives: in our homes and workplaces; through food, air and water; and from everyday household products. Several types of exposures specific to Alaska Natives are also cause for concern, including contaminated traditional foods and proximity to toxic waste sites.^{41, 42} Each of these topics will be explored in ACAT's Breast Cancer Series fact sheets in **Module 2**.

Breast Cancer and Environmental Justice

Women of color in the United States suffer from breast cancer disproportionately compared to other groups, in terms of higher mortality rates and more advanced disease at the time of diagnosis. Black and Latina women have a higher likelihood of death from breast cancer, although the highest incidence is among white women.⁴³ Alaska Native women are more likely to be diagnosed with breast cancer at an earlier age and later stage than white women in the state.^{44, 45} Breast Cancer Action highlights that the breast cancer epidemic is a social justice issue as it harms communities unequally, leading to unacceptable differences in who develops breast cancer and when, who gets sufficient and timely treatment, and who dies from this disease.⁴⁶

Chemicals know no boundaries and some people have disproportionate exposures. Arctic Indigenous Peoples are more highly exposed to persistent and toxic chemicals that are carried north on wind and ocean currents from lower latitudes (known as global transport). These chemicals accumulate in the colder environment and in the bodies of humans and wildlife, including the traditional foods of Arctic Indigenous Peoples.

In multiple studies done in partnership with the people of Sivuaq, Alaska (St. Lawrence Island), research has found that residents of Sivuaq have levels of polychlorinated biphenyls (PCBs, chemicals known to have cancer-causing and hormone disrupting effects) in their blood serum about six times higher than levels found in residents of other U.S. states,⁴⁷ due to exposure from multiple sources: global transport, accumulated levels in traditional foods,⁴⁸ and in some residents, added exposure from the military toxic waste site on the Island at Northeast Cape.⁴⁹ Many Alaska Native communities throughout the state are facing similar challenges from contaminated sites located in close proximity to places where people live, hunt, fish and gather traditional foods.



Photo by Samarys Seguinot-Medina

More than 350,000 chemicals worldwide are currently registered for production and use.

Chemicals found in everyday products from pots and pans, furniture, carpets, clothing, food packaging, cleaning products and personal care products also present a serious threat to Black, Indigenous and People of Color. In 2016, the Environmental Working Group assessed nearly 1,200 products marketed specifically to Black women and concluded that the options for less-hazardous products are limited for this group.⁵⁰ Dr. Ami Zota, a George Washington University assistant professor of environmental and occupational health, said, “Pressure to meet Western standards of beauty means Black, Latina and Asian American women are using more beauty products, and thus are exposed to higher levels of chemicals known to be harmful to health.”⁵¹

Prevention Starts with Education

The United States Centers for Disease Control and Prevention (CDC) recommends education and prevention to reduce exposures and lower cancer rates. In rural communities, the first entry to the Alaska Native health system starts with 170 small clinics staffed by 550 Community Health Aides/Practitioners (CHA/Ps). CHA/Ps are the first person that patients come to for health care in rural Alaska. CHA/Ps receive minimal, if any, training about the prevention of breast cancer by reducing exposures to carcinogenic chemicals other than tobacco and alcohol.

The materials in this toolkit provide information specifically for CHA/Ps on how to recognize and prevent exposure to toxic chemicals in the environment that are linked to breast cancer. We hope that these resources increase awareness of contaminants and human health, benefit patient care and help to improve health and wellbeing in the North/Arctic Region.

PINKWASHING AND BREAST CANCER PREVENTION

Why Focus on Breast Cancer Prevention?

Breast cancer screening, raising awareness and advancing treatment is not enough. A focus on prevention is key to reducing the incidence of breast cancer. ACAT's Breast Cancer Series fact sheets provide information on how to recognize and prevent breast cancer linked to toxic chemicals, as well as how to avoid hazardous exposures. We also acknowledge that prevention is not simply about individual lifestyle choices and purchase decisions, but also social justice and systemic changes on a societal level that impact everyone.

What Is Pinkwashing?

Breast Cancer Action coined the term *pinkwashing* as part of their Think Before You Pink® campaign:⁵²

***Pinkwasher:* (pink'-wah-sheer) noun. A company or organization that claims to care about breast cancer by promoting a pink ribbon product, but at the same time produces, manufactures and/or sells products that are linked to the disease.**

The pink ribbon and other pink imagery and branding are used to raise awareness of breast cancer. However, just because a product has a pink ribbon symbol does not mean that profits from sales of the product will contribute to any actions to prevent breast cancer or support survivors. Any company or manufacturer can put a pink ribbon on a product. **There is no regulation or transparency over the use of the pink ribbon symbol. Corporations attach a pink ribbon to their product to make a profit from people looking to support breast cancer awareness, while many of these products contain ingredients associated with cancer.**^{53, 54, 55}



How Do I Know If a Brand Is Pinkwashing?

Before you buy any pink ribbon items, take a closer look to find out whether your purchase directly supports breast cancer programs, addresses root causes of breast cancer, or is free of toxic chemicals linked to the disease.⁵⁶ Follow these tips from Breast Cancer Action:⁵⁷

1. Can you tell how much (if any) of your purchase will directly support breast cancer programs? Which organization will get the funds and how will they use it?
2. Will the profit from your purchase go toward truly addressing the root causes of the epidemic, such as:
 - Social inequities that lead BIPOC (Black, Indigenous and People of Color) and low-income individuals to face a higher risk of death from breast cancer?
 - Environmental toxic exposures that contribute to high rates of breast cancer?
3. Is the product free of toxic chemicals linked to breast cancer?
 - For example, KFC and Susan G. Komen for the Cure teamed up on a “Buckets for the Cure” campaign, while KFC sells a product that contains a chemical linked to breast and other cancers (2-Amino-1-Methyl-6-Phenylimidazo (4,5-b)Pyridine, or PhIP).^{58, 59}
 - In 2011, Susan G. Komen for the Cure commissioned the “Promise Me” perfume, which contains toxic chemicals that potentially cause cancer and hormone disruption.⁶⁰
 - To learn about some of the toxic chemicals found in consumer products that have been linked to breast cancer, see ACAT fact sheets on Personal Care Products and Cosmetics, and Per- and Polyfluoroalkyl Substances (PFASs) in Household Consumer Products.



Source: pinkribbonblues.org

think before



you pink

a project of

BREASTCANCERACTION.org

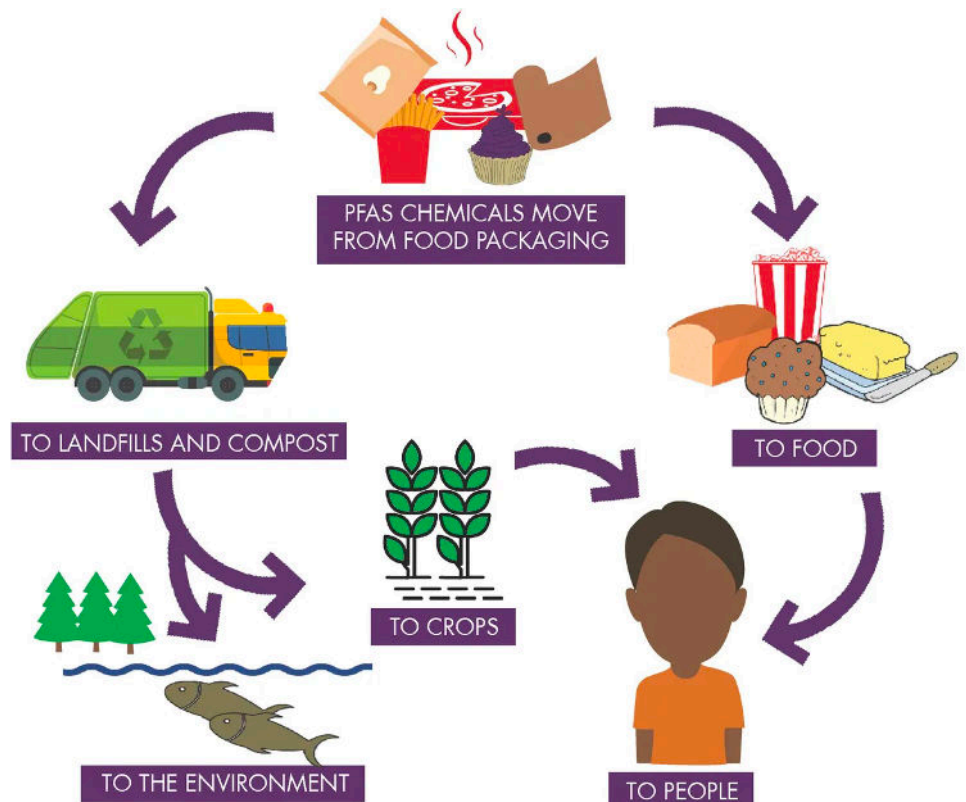


MODULE 2: BREAST CANCER SERIES

FACT SHEETS

This module contains a series of fact sheets that cover the most significant sources of environmental chemical exposures linked to breast cancer. The fact sheets in this module cover the following topics:

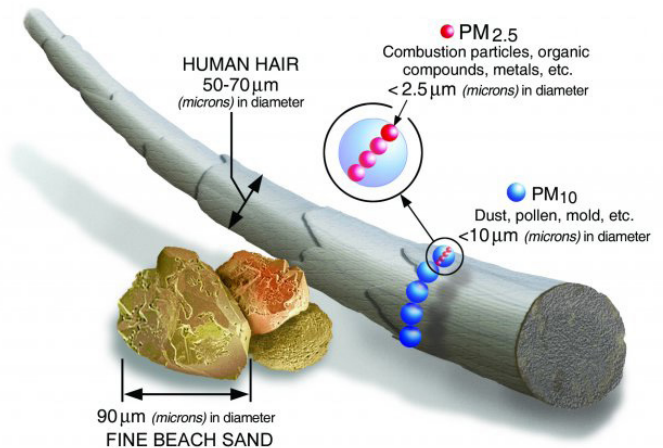
- Air Pollution
- Flame Retardants
- Food Packaging
- Occupational Exposures
- Per- and Polyfluoroalkyl Substances (PFASs) in Household Consumer Products
- Persistent Organic Pollutants: Legacy and Emerging Contaminants
- Personal Care Products and Cosmetics
- Pesticides
- Traditional Foods, Diet and Nutrition



PREVENTING HARM: AIR POLLUTION

What Is Air Pollution?

Air pollution is a complex mixture of solid and liquid particles and gases. Some of the most common components of air pollution are particulate matter (PM), polycyclic aromatic hydrocarbons (PAHs), and nitrogen oxides (NO_x), including nitrogen dioxide (NO₂).⁶⁹ Air pollution is thought to be associated with breast cancer, due to the higher incidence of breast cancer in urban than in rural areas^{70,71} and the link between the increase in breast cancer incidence and increasing traffic emissions over the last 30 years.^{72,73} Tobacco smoke is another source of air pollution that increases breast cancer risk.^{74,75}



Chemicals of Concern in Air Pollution

PM is a mixture of extremely small particles and liquid droplets that disperse into the air. PM is classified by the diameter of the particles:

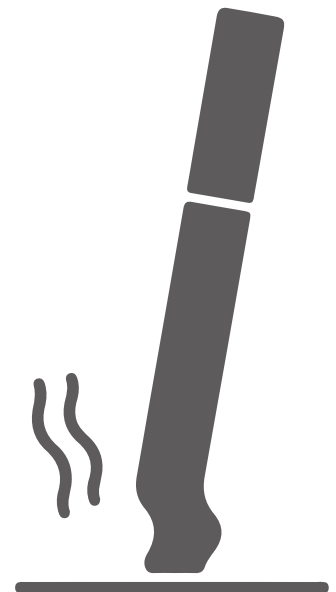
- Fine particles, or **PM2.5**, are less than 2.5 μm (micrometers or microns) in diameter. The average human hair is about 30 times larger in diameter than the largest particle of PM2.5.⁷⁶
- Coarse particles, known as **PM10-2.5** or **PMcoarse**, are between 2.5-10 μm in diameter.
- **PM10** refers to all particles smaller than 10 μm in diameter.
- Ultrafine particles, or **UFPs**, are less than 0.1 μm in diameter.

PM can come from heating sources, road traffic, agriculture, wildfire smoke, and industry.⁶³ PM may include hundreds of different chemicals, as well as particles of dust, dirt, soot and smoke.⁶⁴

PAHs are a class of chemicals that are formed from the burning of organic materials, such as wood, coal, and biofuels, and are also found in vehicle exhaust. These chemicals build up in fatty tissue in the body, including breast tissue.⁶⁵ PAHs have been widely studied in relation to breast cancer as they have carcinogenic and endocrine-disrupting effects.⁶⁶

NO₂ is a highly reactive gas that primarily gets into the air from the burning of fuel, such as emissions from cars, trucks and buses, power plants and off-road equipment.⁶⁷

Benzene is a solvent and an air pollutant commonly found in traffic exhaust.⁶⁸



Tobacco smoke contains thousands of chemicals of concern.⁶¹ Those related to breast cancer risk include benzene and nicotine-derived nitrosamine ketone (NNK).⁶²

How Are We Exposed?

PM10 and PM2.5 are small enough to be inhaled. Some of these particles can get deep into the lungs and even into the bloodstream. The smallest particles, PM2.5, pose the greatest risk to health.⁷⁷ People can be exposed to PAHs through inhaling motor vehicle exhaust, cigarette smoke or wood smoke.⁷⁸ People can also be exposed to NO₂ through inhalation.⁷⁹

Exposure to tobacco smoke occurs from inhalation during active smoking, as well as inhalation of secondhand and thirdhand smoke (otherwise known as passive smoking). Secondhand tobacco smoke is exhaled by active tobacco smokers and from smoldering tobacco. Thirdhand smoke is a residue of active smoking that lingers in the indoor environment long after tobacco smoke has been introduced into the air. Thirdhand smoke can be found in carpets, furniture, blankets, toys,⁸⁰ and can even become embedded within walls, ceilings and floors.⁸¹

Body of Evidence on Breast Cancer Risk

Particulate matter:

A collection of studies throughout Europe found an association between postmenopausal breast cancer and long-term exposure to PM2.5, PM10, PMcoarse and NO₂, and the strongest links with NOx. When examining the specific components of the particles, the strongest associations were found with the elements vanadium in PM10 and PM2.5 and nickel in PM10.⁹⁵ Nickel is known to have estrogenic properties, meaning it has a similar effect on the body as the female reproductive hormone, estrogen.⁹⁶ Another recent animal study found evidence that vanadium lowered levels of estrogen and progesterone, suggesting that vanadium also acts as an endocrine disruptor.^{97,98} Another study from Taiwan showed that PM is associated with DNA-damaging activity and estrogenic effects in human breast cancer cells.⁹⁹

PAHs:

The National Toxicology Program (NTP) and the International Agency for Research on Cancer (IARC) have classified 15 PAHs as reasonably anticipated to be human carcinogens.^{100,101} In animal studies, 13 PAHs have been found to specifically cause mammary gland tumors.¹⁰² PAHs also have been shown to have anti-estrogenic and estrogenic activity.¹⁰³ In the Long Island Breast Cancer Study Project (LIBCSP), researchers found positive associations between breast cancer and estimated traffic-related PAH exposure during early life, menarche (age of first menstruation), and before first childbirth.¹⁰⁴

Elevated incidence of breast cancer was found to be associated with exposure to high levels of PAHs in

traffic emissions. In one study, women with early life exposure to high levels of PAHs were at a higher risk of developing post-menopausal breast cancer.⁸² Another study found higher exposure to PAHs from traffic emissions was associated with increased risk of premenopausal breast cancer in women exposed at menarche, and with postmenopausal breast cancer for mothers at the time of first childbirth.⁸³

PAHs have also been found to bind to DNA and form adducts in the breast tissue, which can cause mutations and set the stage for cancer to develop.⁸⁴

Indoor PAH exposure (from first- and secondhand smoke, consumption of grilled/smoked food, and use of indoor stoves or fireplaces) is also linked to breast cancer. In one study, women who had high indoor exposures to PAHs from these sources had a 30 to 50 percent increase in incidence of breast cancer.^{85,86}

NO₂:

A study of NO₂ in ambient air found elevated associations with postmenopausal breast cancer.⁸⁷

Benzene:

Benzene is a known human carcinogen.^{88,89,90} Exposure to benzene has been linked to mammary tumors in mice.⁹¹ Several occupational studies have found that exposure to benzene and other solvents may be linked to increased risk of breast cancer.⁹² Benzene exposure for longer periods of time and at younger ages has also been found to increase the risk of breast cancer.^{93,94}

Tobacco smoke:

There is a large amount of evidence linking **smoking** to breast cancer from several large epidemiologic studies,¹⁰⁵ notably the California Teachers Study,¹⁰⁶ the Canadian National Breast Screening Study,¹⁰⁷ the Nurses' Health Study,¹⁰⁸ and the Women's Health Initiative Study.¹⁰⁹

NNK is a cancer-causing chemical specific to tobacco that has been found to increase tumor cell proliferation (cell multiplication) and change healthy breast epithelial cells into malignant cancer cells in *in vitro* laboratory experiments.^{110, 111, 112, 113} People may be exposed to greater concentrations of NNK from thirdhand smoke than from active smoking or secondhand smoking, as NNK has been found to increase in thirdhand smoke over time, long after the chemicals from secondhand smoke have broken down.¹¹⁴

Research findings on the link between **secondhand smoke** and breast cancer are inconsistent, with some studies finding that exposure is not linked to breast cancer (no association),¹¹⁵ while others found that exposure increases the risk of breast cancer (positive association).^{116, 117, 118, 119, 120} Recent epidemiologic studies have provided more evidence that exposure to high levels of secondhand smoke is associated with breast cancer.¹²¹ Another recent study found that secondhand smoke is a stronger cause of breast cancer than of lung cancer in younger, primarily premenopausal women.¹²²

IS IT SAFER INDOORS?

Not necessarily. Indoor heating and cooking through the burning of wood or gas in the home may create similar hazards as those observed in outdoor air, including PM, PAHs, and benzene. In epidemiologic studies, there were higher associations of breast cancer with stove/fireplace use.^{123, 124, 125} Exposure to tobacco smoke is also a concern for indoor air quality, not only for active smokers but also those exposed involuntarily to passive smoke.



PROTECT YOUR HEALTH

Here are some ways you can reduce your exposure to air pollution:

- Avoiding or limiting exposure to air pollution is the best way to decrease risk. The United States Environmental Protection Agency (EPA) and partners have made it easy to find out when the Air Quality Index (AQI) is at a high or unsafe level. Visit www.airnow.gov to see the current air quality in your area and limit outdoor activities on days with higher AQI.
- Install and use HEPA (high efficiency particulate air) filters throughout the home to improve indoor air quality. These filters are designed to remove at least 99.97% of dust, pollen, mold, bacteria, and airborne particles.¹²⁶
- Open windows or use one or more fans to circulate air.
- Keep engines properly tuned to use less fuel.
- Avoid burning leaves, trash, and other materials.
- Consider carpooling, using public transit, or biking and walking.
- If choosing to exercise outdoors, try to choose a location away from busy roads, highways, traffic, generators, or other sources of air contaminants to avoid breathing chemicals from exhaust.

PREVENTING HARM: FLAME RETARDANTS

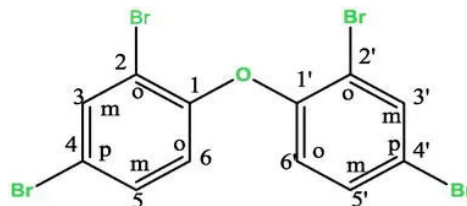


What Are Flame Retardants?

Flame retardants are chemicals used to slow or prevent flammability in a wide range of consumer products. There are hundreds of different types of flame retardants, generally grouped into categories based on their chemical structure and properties, such as whether they contain bromine, chlorine, phosphorus, or other chemicals.¹²⁷

Chemicals of Concern

Polybrominated diphenyl ethers (PBDEs) are a group of flame retardant chemicals linked to breast cancer. PBDEs are added to many consumer products such as electronics, furniture foams, fabrics, kitchen appliances, and upholstery in furniture, mattresses and car seats.¹²⁸ In 2004, the industry voluntarily ended manufacture and import into the United States of certain PBDEs (penta- and octaBDE) after high levels were found in breast milk. The largest manufacturers and importers of decaBDE in the United States phased out use of the chemical by the end of 2013.^{129, 130}



After these forms of PBDEs were phased out, industry largely began using replacement chemicals with limited data on health and safety. In some cases, these substitutes were later found to be just as toxic as PBDEs – in effect, trading one problem for another, also known as “regrettable substitution.”¹³¹

Some of these substitute chemicals include:

- Other brominated flame retardants such as 2,2-bis(bromomethyl)-1,3-propanediol (BBMP) and tetrabromobisphenol A (TBBPA).
- Organophosphate flame retardants (OPFRs) are also used as substitutes for PBDEs in similar products. Some commonly used OPFRs include **triphenyl phosphate (TPP)**, **tris(1,3-dichloroisopropyl) phosphate (TDCPP)** and **tris(2-chloroethyl) phosphate (TCEP)**.

How Are We Exposed?

With products containing flame retardants all around us, people are continually exposed.¹³² Although penta-, octa- and decaBDE have been banned the United States, these chemicals are still present within old furniture and other consumer products made before their respective phase-outs.¹³³ Most flame retardants easily released from products after normal use and wear and tear over time.^{134, 135} This causes them to be present in the air we breathe and in household dust at concerning levels.^{136, 137}

Research has shown that several flame retardants are also able to travel long distances on wind and ocean currents to the Arctic from sources all over the Northern Hemisphere.^{138, 139} These chemicals are considered persistent organic pollutants (POPs), which are known to be persistent, bioaccumulative and toxic (*for more information, see ACAT fact sheet on POPs*).¹⁴⁰ Because of these characteristics, POPs build up in concentration over time in the environment and have been found in the bodies of fish, wildlife, and people of the Circumpolar North.¹⁴¹ Most POPs build up in fatty tissue and thus can be found in high concentrations in the fat-based Arctic food web.



In a study done in partnership with the people of Sivuqaq, Alaska (St. Lawrence Island), residents of Sivuqaq were found to have elevated levels of PBDEs in their blood serum and in household dust. This indicates that exposure is likely due to both the traditional diet and the home indoor environment.¹⁴² This study also found PBDEs present in fish species on the Island which suggests that people are exposed from multiple sources: global transport, accumulated levels in traditional foods, and the military toxic waste site on the Island at Northeast Cape. Though traditional foods are a potential route of exposure to contaminants in the Arctic environment, nevertheless they remain **the best source of sustenance for Alaska Native peoples as they are both nutritionally rich and culturally essential.**

The primary routes of exposure to flame retardants are inhalation, hand-to-mouth contact, absorption through the skin, and consumption of contaminated foods:¹⁴³

PBDEs:

- Incidental intake when PBDE-contaminated dust present on hands and food is ingested while eating food.^{144, 145} Out of all possible exposure routes, the highest intake of decaBDE results from household dust.^{146, 147, 148}
- Eating contaminated foods^{149, 150}
- Eating fatty foods such as meat, fish, marine mammals and dairy products.^{151, 152} Concentrations of PBDEs have grown over the years in marine mammals.¹⁵³ People of the Arctic may experience an even higher risk of exposure due to their traditional diet rich in fat from marine mammals and other sources.¹⁵⁴
- PBDEs have been found in mothers' breast milk and in the blood of mothers and their babies.^{155, 156, 157, 158} Because PBDEs are highly fat soluble, they build up in breast milk and can be a major source of exposure for breastfed infants.^{159, 160}
- Some PBDEs can pass from mother to fetus during pregnancy through the placenta.¹⁶¹

TBBPA:

- Research has found that people may be exposed to TBBPA through the skin via contaminated dust.¹⁶²
- TBBPA can pass from mother to fetus during pregnancy through the placenta.¹⁶³

BBMP:

- The primary routes of human exposure to BBMP are inhalation and dermal contact.¹⁶⁴

OPFRs:

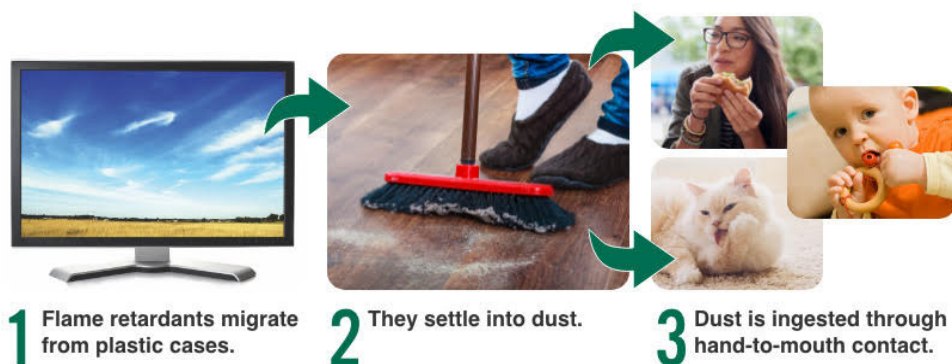
- OPFRs have been found at even higher levels via hand-to-mouth and skin transfer pathways than for PBDEs.¹⁶⁵
- Dietary sources of OPFR exposure have also been reported. In one study of OPFR levels in food samples from around the world, the animal-based foods category showed the highest median concentrations found in meat and fish from the United States.¹⁶⁶
- Another study found OPFRs migrate into food from food packaging materials.¹⁶⁷

Body of Evidence on Breast Cancer Risk

A case-control study at the Alaska Native Medical Center confirmed the correlation between serum concentrations of one **PBDE** congener and breast cancer in Alaska Native women.¹⁶⁸ Another study found that women with higher levels of most of the 14 individual PBDEs studied, as well as higher levels of all 14 PBDEs combined, had an increased risk of breast cancer.¹⁶⁹ Some **PBDEs** have been found to promote estrogenic-like growth of human breast cancer cells *in vitro* in laboratory experiments.¹⁷⁰

Other studies also show that **PBDEs** counteract the anti-cancer effects of the breast cancer treatment drug tamoxifen in cultured breast cancer cells.¹⁷¹ Exposure to BDE-47, one of the most common **PBDEs** in people's bodies, was also found to be associated with increased oxidative stress, a process linked to increased risk of breast cancer.¹⁷²

Many currently used flame retardants have demonstrated endocrine disrupting activity in animal or *in vitro* studies, including **TBBPA**, **TPP** and **TCEP**.^{173, 174} Additionally, **BBMP** and **TDCPP** increase the risk of mammary tumors in rodents.¹⁷⁵ These studies suggest a link between these chemicals and increased breast cancer risk.¹⁷⁶



Source: Green Science Policy Institute

Reduce Your Exposure

Here are some ways you can reduce your exposure to flame retardants:

Breastfeeding:

- We always strongly encourage mothers to breastfeed their babies. Breastmilk contains extremely valuable nutrition for babies and is highly important for healthy growth and development. The research consistently shows that the benefits of breastfeeding generally outweigh any potential risks from chemicals that may be present in breastmilk.¹⁷⁷
- In communities at risk of chemical exposures, the benefits of breastfeeding still generally outweigh any potential risks because breast milk can help to reduce any harmful effects of the chemicals on infants.^{178, 179, 180, 181}

Flame retardant-free furniture:

- Before purchasing furniture, make sure that it is flame retardant-free:
 - Find out which companies offer flame retardant-free products. Many companies, including Wal-Mart, Ikea and Sam's Club, have stopped carrying products with PBDEs.¹⁸²
 - For other companies, email or call the product manufacturer and ask them if they use flame retardants.
 - For examples of suppliers and brands that offer upholstered furniture without added flame retardants, visit: <https://greensciencepolicy.org/docs/furniture-fact-sheet-17-03-13.pdf>

- The Mind the Store campaign publishes annual report cards and rankings of retailers by use of toxic chemicals in furniture and other consumer products: <https://retailerreportcard.com/grades/>
- Choose furniture made with less flammable fabrics like leather, wool and cotton. Furniture can meet flammability standards without the use of chemical flame retardants.
- Most furniture is now labeled with chemical flame-retardant content. Look for a label that states whether or not the product contains added flame retardants.¹⁸³
 - If the label says, “CONTAINS NO ADDED FLAME RETARDANTS”, that means it’s free of flame retardants.
 - If label says, “CONTAINS ADDED FLAME RETARDANTS”, that means it contains flame retardants.
 - If the label says the product meets Technical Bulletin (TB) 117 standards and has no additional information, it meets an outdated standard and is likely to contain flame retardants.¹⁸⁴

Flame retardants in carpeting and foam padding:

- Carpeting and furniture with foam padding purchased before 2005 are likely to contain PBDEs. Make sure these items are completely covered in fabric with no rips.
- If you have older furniture and cannot afford to replace it, repair any tears or gaps in the fabric that cover the foam rather than reupholstering it.
- Be very careful when removing old carpet and foam padding. Try to keep your work area separated from the rest of the house by using plastic sheeting to cover surrounding floors and furniture; carefully remove old carpet in sealed plastic bags or wrapped in plastic sheeting; and use personal protective equipment (PPE) such as safety glasses, masks, gloves and work clothes. After the work is complete, or at the end of each work day, carefully clean up the area (see section below on reducing dust exposure).
- Choose furniture filled with cotton, polyester or wool, which are unlikely to contain added flame retardants, instead of polyurethane foam.¹⁸⁵
- Choose furniture without filling (e.g., wood, wicker).¹⁸⁶

Flame retardant-free electronics:

- Many companies are beginning to make electronics with alternatives to PBDEs. Certain PBDE-free products



“

What do breast milk and polar bears have in common?

In 1999, some Swedish scientists studying women’s breast milk discovered something totally unexpected: The milk contained an endocrine-disrupting chemical found in fire retardants, and the levels had been doubling every five years since 1972!

These incredibly persistent chemicals, known as polybrominated diphenyl ethers or PBDEs, have since been found to contaminate the bodies of people and wildlife around the globe – even polar bears.”
(Environmental Working Group)

- available from Canon, Dell, HP, Intel, Erickson, Apple, Acer, Nokia, Motorola, LG Electronics, and Sony.¹⁸⁷
- Greenpeace USA's *Guide to Greener Electronics* evaluates what the world's leading consumer electronics companies are doing to address their environmental impacts: https://www.greenpeace.org/usa/wp-content/uploads/2017/10/GGE17_ReportCards.pdf
- Visit the Mind the Store campaign's annual report cards and rankings of retailers by use of toxic chemicals in electronics: https://retailerreportcard.com/grades/?fwp_sector=electronics

Reduce your dust exposure:

- Wash your hands often to remove dust particles that your hands pick up throughout the day from everything you touch.
- Use a damp mop, rag or cloth while dusting to avoid kicking up the dust in the air.¹⁸⁸
- If possible, use a vacuum fitted with a high efficiency particulate air (HEPA) filter. These vacuums can trap smaller particles of dust and will be more likely to remove contaminants from your home.¹⁸⁹
- Vehicles and children's car seats have been exempted from flame retardant regulations, and high levels of these chemicals have been found inside cars.^{190,191} Removing dust with a wet cloth and keeping car seat cushions in good condition and free of tears will help to reduce your exposure.
 - Visit the Ecology Center's Healthy Stuff program for a list of flame retardant-free car seats currently on the market: <https://www.ecocenter.org/healthy-stuff/pages/flame-retardant-free-children's-car-seats>

Reduce your intake of fats:

- Choose leaner cuts of meat and poultry whenever possible, as some POPs such as PCBs and DDT are stored in the fat of animals.^{192,193}
- Remove or trim more fat and blubber on meat and fish.
- Consume lesser amounts of rendered oils whenever possible.
- Choose cooking methods that remove excess fat whenever possible, such as broiling, grilling and roasting.
- Consider eating smaller amounts of dairy products, or choose low-fat or non-fat dairy products if available.



PREVENTING HARM: FOOD PACKAGING

All About Food Packaging

Food packaging is designed to contain and protect food products in order to keep them safe from spoiling. However, food packaging may also contain harmful chemicals that leach into foods. Companies in the United States are not required to list chemicals used in food packaging materials, and there is limited regulatory oversight in managing potential harmful health effects.¹⁹⁴



Chemicals of Concern in Food Packaging

Some common chemicals found in food packaging include per- and poly-fluoroalkyl substances (PFASs), bisphenol A (BPA), and phthalates.^{195, 196, 197}

PFASs:

Per- and polyfluoroalkyl substances (PFASs) are chemicals used in non-stick cookware, grease-proof food packaging, and a wide range of other consumer products. Some of the commonly used PFASs include perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and perfluorooctane sulfonamide (PFOSA).

In October 2021, the State of California passed the Safer Food Packaging and Cookware Act (AB 1200), which bans paper-based food packaging containing PFAS chemicals, requires cookware manufacturers to disclose the presence of hazardous chemicals, and prohibits misleading advertising on cookware packaging.¹⁹⁸ With this law, California joins 18 other states that have passed similar laws regulating PFAS chemicals in food packaging.¹⁹⁹

BPA:

Bisphenol A (BPA) is a chemical used in hard plastic (polycarbonate) products, including water bottles, food storage and heating containers, and in the lining of metal food cans.^{200, 201} Polycarbonate plastic can become unstable over time and with use, allowing BPA to leach into material in contact with the plastic.²⁰² To date, 13 states have adopted legislation that limits the use of BPA in baby bottles, sippy cups and/or other food and beverage containers.²⁰³

Phthalates:

Phthalates are a group of chemicals used to make plastics soft or flexible.²⁰⁴ They are used in a wide variety of consumer products, including food packaging materials such as plastic wrap/cling film and printing inks used in paper and board-packaging.²⁰⁵

To date, five states have adopted legislation that limits the use of phthalates in children's products, food packaging and/or other consumer products.²⁰⁶

How Are We Exposed?

Hazardous chemicals found in food packaging materials can be released into food and may be unknowingly ingested by consumers. The primary route of exposure to PFASs occur through ingesting contaminated food and water. Exposures can also occur in using consumer products containing

PFASs, such as food packaging and non-stick cookware.^{207, 208} Humans are exposed to BPA daily through consumption of food and beverages contaminated with BPA, as well as from environmental contamination.^{209, 210} BPA is now present nearly everywhere in the environment and can be found in household dust²¹¹, surface water and drinking water.²¹²

Body of Evidence on Breast Cancer Risk

PFASs, BPA and phthalates have all been linked to breast cancer incidence in low doses.²¹³ These chemicals are considered endocrine disrupting chemicals (EDCs) that can act like hormones or interfere with normal functioning of the hormone system, which can then negatively affect our health. Many EDCs have non-linear effects in the body, meaning there is not necessarily greater risk with greater exposure. Lower doses may have greater adverse effects than higher doses. Sometimes the timing of exposure determines the potential effect – whether exposure occurs *in utero*, during infancy, puberty, or later in life.

The evidence from epidemiologic (human) studies linking EDCs to breast cancer risk is still mixed – some studies have found that exposure to these chemicals increases the risk of breast cancer (positive association), while others have found that exposure protects against breast cancer (negative association) or is not associated. More studies need to be done to understand the relationship between exposure and disease; nevertheless, we know enough to take precautions against potentially harmful exposures.

The following studies have linked these chemicals to breast cancer risk:

PFASs (for more information, see ACAT fact sheet on PFASs):

- Higher risk of breast cancer in Inuit women in Greenland linked to PFOS, PFOA and total PFAS levels.^{214, 215}
- Higher risk of breast cancer in pregnant women in Denmark linked to PFOSA exposure (perfluorooctane sulfonamide, another PFAS compound).²¹⁶
- Higher risk of estrogen-receptor positive (ER+) tumors in Taiwanese women aged 50 and under associated with exposure to perfluorohexanesulfonic acid (PFHxS) and PFOS.²¹⁷
- Higher risk of breast cancer in urban Filipinas associated with PFASs.²¹⁸
- Higher risk of receptor-positive (ER+/PR+) tumors in French women associated with PFOS, while only low levels of PFOS and PFOA were associated with receptor-negative (ER-/PR-) tumors.²¹⁹ No overall association was found between PFAS levels in blood serum with risk of





- breast cancer.
- Lower risk of breast cancer among Japanese women with serum concentrations of 20 PFAS congeners. Mixed results were found among postmenopausal women, with some experiencing marginally higher breast cancer risk and others less likely to develop breast cancer, depending on different isomers of perfluorotridecanoic acid (PFTrDA).²²⁰
- In mothers in a California study, higher levels of PFOS in maternal blood around the time of giving birth were associated with a lower risk of their daughters developing breast cancer before the age of 52. However, when higher maternal levels of one PFOS chemical were combined with higher maternal cholesterol levels, their daughters had a 3.6-times greater risk of breast cancer.²²¹
- In rodent studies, PFOA exposure was associated with delayed mammary gland development,^{222, 223, 224} altered mammary gland development, and disrupted lactation in mothers.²²⁵

BPA:

- The evidence from human studies linking low-dose exposure of BPA (at levels commonly found in the environment) to breast cancer is inconsistent, with several studies finding no association.^{226, 227, 228} However, a recent review of studies on low-dose BPA exposure and breast cancer in animal and *in vitro* studies concluded that BPA induces mammary gland tumors.²²⁹
- Several laboratory studies on rats and mice have shown that prenatal exposure to BPA is linked to abnormal mammary gland development that begins during gestation and continues into adulthood.^{230, 231, 232, 233}
- An animal study on pregnant rats and female litters found that prenatal exposure to BPA had different effects in offspring based on the concentration of exposure. In one study, low-dose exposures altered gene expression in the mammary tissues of offspring to a greater degree just before reproductive maturity, while higher doses had a delayed effect in mature offspring.²³⁴
- *In vitro* studies have found that BPA decreases the effectiveness of chemotherapy agents (cisplatin, doxorubicin and vinblastin) used for breast cancer.^{235, 236}

Phthalates (for more information, see ACAT fact sheet on Personal Care Products and Cosmetics):

- In a study of Alaska Native women, MEHP was associated with increased risk of breast cancer, but no association with other phthalate metabolites was found.²³⁷
- A study on breast cancer risk in women of northern Mexico found that higher urinary levels of MEP were associated with increased risk of breast cancer.²³⁸ This association was twice as high in premenopausal women. However, this study also found that urinary levels of MBzP and MCPP were associated with a decrease in breast cancer risk.
- In a multiethnic study, women with the highest urinary levels of DEHP metabolites had an increased risk of developing breast cancer, and this effect was highest in Native Hawaiian

- women.²³⁹
- A large, prospective study on urinary levels of 13 phthalate metabolites and postmenopausal breast cancer found no association between breast cancer risk and phthalate exposure.²⁴⁰
- Another human study found increased levels of MMP were associated with early breast development in healthy adolescent girls before age eight,²⁴¹ a known risk factor for breast cancer.²⁴²
- Animal studies have shown that abnormalities in mammary tissue development were found in very young rats exposed to BBP,²⁴³ as well as those exposed *in utero*.²⁴⁴
- *In vitro* studies have shown that BBP and DBP trigger proliferation (cell multiplication) of breast cancer cells, malignant invasion, and formation of tumors of a certain type of breast cancer (receptor-negative breast cancer).^{245, 246} Another *in vitro* study found BBP promotes breast cancer stem cell growth.²⁴⁷
- Another *in vitro* study found DEHP exposure increased the proliferation of human breast cancer cells by interfering with the progesterone receptor system.²⁴⁸
- A recent study from the Long Island Breast Cancer Study Project found that women with high levels of metabolites of DEHP in urine and low to normal body mass index (BMI) had higher mortality rates from breast cancer, while women with BMIs in the overweight and obese range had lower risk with higher levels of DEHP metabolites.²⁴⁹
- In laboratory studies, phthalates have been associated with breast cancer stem cell growth,²⁵⁰ proliferation of human breast cancer cells,²⁵¹ and abnormalities in mammary tissue development in rodents.^{252, 253}



Reduce Your Exposure

Individuals can take the following steps to reduce exposure to chemicals associated with food packaging materials:²⁵⁴

- As much as possible, reduce consumption of canned or moist food packaged in cardboard or plastic. Choose fresh or frozen foods whenever possible.
- Store food in glass, wax paper, or stainless steel instead of plastic.
- Use glass or stainless-steel water bottles instead of plastic.
- Avoid microwaving any food in plastic.
- Avoid storing in or prepping/cutting food on cardboard unless it is a safe, food-grade alternative.

PREVENTING HARM: OCCUPATIONAL EXPOSURES

What Are Occupational Exposures?

Occupational exposures to potentially hazardous substances or conditions may occur in the workplace.²⁵⁵ Women and men may have a higher risk of breast cancer from working in settings with high exposure to carcinogens (cancer-causing substances) and endocrine disruptors (hormone-disrupting substances).

How Are We Exposed?

People may experience occupational exposures in several ways:

- Skin contact with chemicals in the workplace, including paint, gasoline, diesel fuel, pesticides and solvents.
- Breathing in chemicals in air, dust, or fumes:
 - Solvents may evaporate into the air when working with consumer products such as paint or gasoline.^{256, 257}
 - Many occupations generate dust which may be inhaled by workers, including mining, construction, manufacturing, agricultural work and food processing.²⁵⁸
- Ionizing radiation exposure from medical procedures (imaging tests including x-rays, CT scans, PET scans and bone scans) or chemotherapy treatments.



Body of Evidence on Breast Cancer Risk

Occupational health studies mainly focus on single exposures or a few exposures at a time, but in reality many workers are exposed to combinations of multiple chemicals throughout the workday and may also be exposed to harmful chemicals in their homes and communities. Some studies examine the links between certain professions and health effects without pinpointing specific exposures of concern. Therefore, it can be difficult to know which specific substances are linked to the health effects studied. Breast cancer has been linked to the industries and occupations listed here (any known occupational exposures are highlighted in bold):²⁵⁹

Medical field:

- **Ionizing radiation** for workers in the medical diagnostics field, with higher mortality rates correlated to occupational exposures occurring before 1950, before preventive measures were put into practice.^{260, 261, 262}
- Some studies found elevated risk of breast cancer among nurses,^{263, 264} particularly those

- working in hospital settings and with longer duration of employment.²⁶⁵

In studies of other medical professionals, orthopedic surgeons were found to have nearly three times higher risk of breast cancer, potentially from high levels of radiation exposure during procedures.²⁶⁶ Physicians were found to have double the risk,²⁶⁷ and medical and healthcare personnel had a 40 percent higher risk.²⁶⁸

Production industries:

- Workers in the metalworking industry were found to have double the risk of a certain subtype of breast cancer (estrogen receptor-positive and progesterone receptor-positive, or ER+/PR+ breast cancer).²⁶⁹
- Women in the automotive plastics and food canning industries were found to have a higher risk of breast cancer, with a five-times greater risk among premenopausal women and twice the risk among postmenopausal women.²⁷⁰
- A study of Thai women found that industrial workers in the production industries, transport equipment operators and laborers employed for more than 10 years were found to have a higher risk of breast cancer.²⁷¹

Chemical exposures:

- In a study of enlisted women in the United States Army with high exposure to **volatile organic compounds (VOCs)**, Black women had higher incidence of breast cancer compared to white women of the same age and exposure levels.²⁷²
- A study of Marines exposed to contaminated drinking water at Camp Lejeune in North Carolina found that VOCs including **trichloroethylene (TCE)**, **tetrachloroethylene (PCE)**, **1,2-dichloroethylene (DCE)**, and **vinyl chloride** were linked to male breast cancer.²⁷³
- In a study of female aircraft maintenance workers, results were inconclusive but suggested a slightly higher risk of breast cancer among workers exposed to **TCE**, particularly among those exposed to **freon, solder flux, trichloroethane, methylene chloride, metal fumes and dusts, isopropyl alcohol, and other alcohols**.²⁷⁴ This study was not able to attribute risk to any specific chemicals as the workers were often exposed to multiple chemicals at once.
- **Dioxin (TCDD)** exposure is associated with increased breast cancer risk,^{275,276} with the greatest occupational exposure risk in the production of phenoxy herbicides and chlorophenols.²⁷⁷
- Men exposed to **solvents, gasoline fumes and vehicle combustion products** from working in the automotive industry, painting, papermaking, forestry and logging have a significant increase in breast cancer risk.²⁷⁸
- Studies have found evidence supporting the link between occupational **benzene** exposure to breast cancer risk in female workers in various occupations, including clinical laboratory technologists and technicians, painters, sculptors, craft artists, print makers, assemblers in the motor vehicles industry,²⁷⁹ and shoe factory workers.²⁸⁰
- Occupational studies of agricultural workers have found **pesticide** exposure linked to breast cancer, from terbufos pesticides and methyl bromide²⁸¹ to malathion, chlordane and 2,4-D.²⁸²

Beauty industry:

- A 2009 review of studies found a small increase in breast cancer risk among hairdressers, barbers and beauticians.²⁸³ This effect was found in populations all over the world, but no specific exposure was identified. Hairdressers and related workers are routinely exposed to **volatile solvents, propellants and aerosols** from hair sprays; **formaldehyde, methacrylates, nitrosamines** and thousands of other chemicals in hair care products;²⁸⁴ and **chemicals in hair dyes**, many of which are potentially carcinogenic.^{285, 286}

Reduce Your Exposure

Here are some ways you can reduce your exposures in the workplace:

- Ventilation is one of the most effective ways to improve indoor air quality.²⁸⁷ When possible, open doors, windows and vents to reduce the level of indoor air pollutants.
- When using products with solvents, such as paints, glues, cleaners, nail polish and some detergents, make sure they are used in well-ventilated areas, open windows or use fans.
- Never mix cleaning solutions or solvents, because it can create vapors that may be hazardous or deadly.²⁸⁸
- Gasoline and exhaust are major sources of solvents and other contaminants. Turn off the engines of cars, ATVs and snow machines when not needed.
- Wash your hands often to remove dust particles that your hands pick up throughout the day.²⁸⁹
- Use a damp rag or cloth while dusting to avoid kicking up dust in the air.²⁹⁰
- If possible, use a vacuum fitted with a HEPA (high efficiency particulate air) filter. These filters can trap smaller particles of dust and contaminants in your workplace.²⁹¹
- If you are exposed to pesticides at work, it is advised to leave contaminated clothes, tools and other items at work or outside before you return home, shower at work or soon after you return home, or remove shoes and outerwear before entering your home.
- When trying to remove oil from hands, use non-toxic, water-based solvents instead of kerosene and benzene whenever possible.²⁹²
- Wear gloves or use a barrier cream made to protect skin from petroleum products when repairing vehicles.²⁹³
- Wear protective clothing and equipment so that your skin is not exposed to gasoline. If your skin is exposed to gasoline, wash it thoroughly.
- Wash your hands carefully before eating, smoking, drinking or using the toilet if you have been handling petroleum products.
- Wash clothing that has been contaminated with gasoline separate from other clothing.
- Install a carbon monoxide detector in your workplace.



PREVENTING HARM: PER- AND POLYFLUOROALKYL SUBSTANCES (PFASs) IN HOUSEHOLD CONSUMER PRODUCTS

What Are Per- and Polyfluoroalkyl Substances (PFASs)?

Per- and polyfluoroalkyl substances (PFASs) are a family of chemicals that have been widely used in manufacturing and in consumer products since the 1940s. They are used in water-resistant and waterproof products, non-stick cookware, stain-resistant fabrics, grease-proof food packaging, and in aqueous film forming foam (AFFF) used to put out fires associated with jet fuel. Some of the commonly used PFASs include perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorooctane sulfonamide (PFOSA) and perfluorocarboxylates (PFCAs).

PFASs are sometimes known as “forever chemicals,” as they are extremely persistent in the environment. Some build up in concentration (bioaccumulate) in the fatty tissues of animals and humans.

PFASs are ubiquitously present in the environment with 98% of U.S. residents having detectable concentrations of PFASs in their blood.²⁹⁴

PFASs in the Arctic

In a study done in partnership with the people of Sivuaq, Alaska (St. Lawrence Island), residents of Sivuaq were found to have elevated levels of long chain PFASs in their blood serum, likely due to exposure from the traditional diet.²⁹⁵ This study also found PFASs present in fish species on the Island which suggests that people are exposed from multiple sources: global transport, accumulated levels in traditional foods, and the military toxic waste site on the Island at Northeast Cape.

Certain PFASs (very long-chain PFCAs) were previously reported in Arctic marine wildlife, particularly in seabirds²⁹⁶ and their eggs^{297, 298} and are now found in freshwater fish, seals, polar bear and reindeer.²⁹⁹

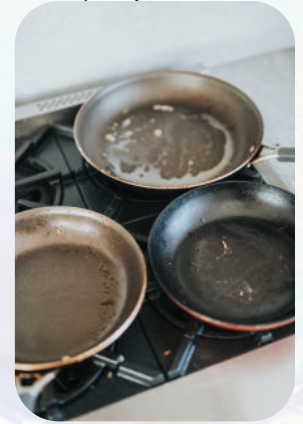
Monitoring studies throughout the Arctic have found PFASs in liver of beluga whales from Cook Inlet in southeast Alaska and the eastern Chukchi Sea in northwestern Alaska. Longer chain PFCAs were nearly 3 times higher in Cook Inlet beluga than in eastern Chukchi Sea animals.³⁰⁰ Cook Inlet beluga also had higher levels of total PFCAs than reported for Hudson Bay beluga.³⁰¹ The concentration of total PFCAs in beluga from Cook Inlet and the Chukchi Sea increased rapidly from 1993-2003 and afterward began to decline.³⁰²

In October 2021, the State of California passed the Safer Food Packaging and Cookware Act (AB 1200), which bans paper-based food packaging containing PFAS chemicals, requires cookware manufacturers to disclose the presence of hazardous chemicals, and prohibits misleading advertising on cookware packaging.³⁰³ With this law, California joins 18 other states that have passed similar laws regulating PFAS chemicals in food packaging.³⁰⁴

How Are We Exposed?

Exposure to PFASs primarily occurs through the ingestion of contaminated food and water. Exposures can also occur from use of consumer products containing PFAS chemicals, such as food packaging, non-stick cookware, water-resistant clothing, and personal care products.^{305, 306} (For more information, see ACAT fact sheet on PFAS in Food Packaging).

Drinking water from the tap may also be contaminated with PFASs. According to an investigative report published by ACAT in 2019, Alaska is in the early stages of investigating known and suspected sources of PFAS contamination to evaluate the potential for impacts to drinking water.³⁰⁷ To date, PFASs have been discovered at over 100 individual sites in nearly 30 locations since the U.S. Department of Defense and State of Alaska first began investigating PFAS contamination. Ten Alaska communities have PFASs in their drinking water at levels deemed unsafe by the U.S. Environmental Protection Agency (EPA), and it is likely that the number of communities found to have contaminated water will grow as more sampling is conducted throughout the state.



Body of Evidence on Breast Cancer Risk

Many adverse health effects have been linked to PFAS exposure, including disruption of the normal functioning of the endocrine (hormone) system.^{308, 309} Substances that have this effect are known as endocrine-disrupting chemicals (EDCs). Some EDCs act like hormones in the body, while others block natural hormones from doing their jobs. EDCs may also increase or decrease the levels of hormones in our blood.³¹⁰ Many EDCs have non-linear effects in the body, meaning there is not necessarily greater risk with greater exposure. Lower doses may have greater adverse effects than higher doses. Sometimes the timing of exposure determines the potential effect – whether exposure occurs *in utero*, during infancy, puberty, or later in life.

The evidence from public health studies linking PFASs to breast cancer risk is still inconsistent and uncertain – some studies have found that exposure to these chemicals increases the risk of breast cancer (positive association), while others have found that exposure protects against breast cancer (negative association) or is not associated. More studies need to be done to understand the relationship between exposure and disease; nevertheless, we know enough to take precautions against potentially harmful exposures.

The following studies have linked these chemicals to breast cancer risk:

- A study of Inuit women in Greenland showed higher blood serum levels of PFOS, PFOA and total PFASs are linked to a higher risk of breast cancer.^{311, 312}
- A study on pregnant women in Denmark found a significant positive association between serum levels of PFOSA and breast cancer.³¹³
- In a study of Taiwanese women, those aged 50 and under had a higher risk of estrogen-receptor positive (ER+) tumors associated with exposure to perfluorohexanesulfonic acid (PFHxS) and PFOS.³¹⁴
- A study of urban Filipinas found that PFASs were positively associated with breast cancer. The study also found that levels of long-chain PFASs were significantly higher in women from a heavily industrialized part of the region.³¹⁵
- In a study done in French women, there was no overall association found between PFAS levels

- in blood serum with risk of breast cancer. However, varying results were found depending on the concentration of the exposure. This study found PFOS levels had a linear association with receptor-positive (ER+/PR+) tumors (greater exposure resulted in greater risk of disease), while only low levels of PFOS and PFOA were associated with receptor-negative (ER-/PR-) tumors.³¹⁶
- A study of Japanese women found serum concentrations of 20 PFAS congeners were associated with a lower risk of breast cancer. Mixed results were found among postmenopausal women, with some experiencing marginally higher breast cancer risk and others less likely to develop breast cancer, depending on different isomers of perfluorotridecanoic acid (PFTrDA).³¹⁷
- A study of data from the California Teacher’s Study found total PFAS levels at 15 months after diagnosis were not associated with risk of developing breast cancer. However, higher levels of PFHxS were associated with greater risk of ER-/PR- breast cancer.³¹⁸
- More recent studies are examining other factors that may influence the relationship between PFAS levels and breast cancer risk. One study from California’s Child Health and Development Studies research program found higher levels of PFOS in maternal blood around the time of giving birth were associated with a lower risk of their daughters developing breast cancer before the age of 52. However, higher maternal levels of one PFOS chemical, combined with higher maternal cholesterol levels, were associated with a 3.6-times greater risk of breast cancer in their daughters.³¹⁹
- Studies in rodents have found that exposure to PFOA delays mammary gland development,^{320, 321, 322} alters mammary gland development in female mouse pups, and disrupts lactation in mothers.³²³
- In a cell culture study, both PFOA and PFOS were found to increase the effects of estrogen in certain breast cancer cells,³²⁴ a sign that these chemicals may influence the risk of developing breast cancer.

Reduce Your Exposure

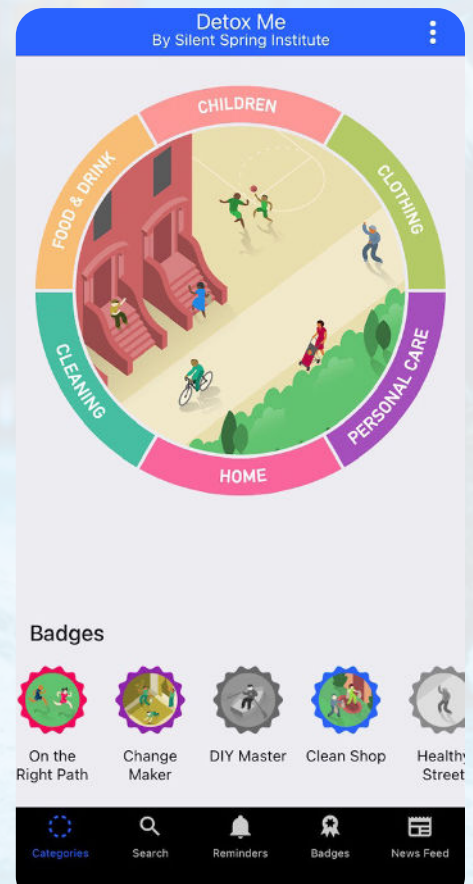
Here are some ways you can reduce your exposure to PFASs in household consumer products:

Avoid products containing PFASs:

- Avoid using non-stick pans and cookware for cooking and preparing food.
- Many consumer products are sources of PFAS chemicals. Water-resistant clothing, stain resistant fabrics and home goods may all contain PFASs. Make sure to check the labels of products looking for ingredients that contain “per-“ or “polyfluoro-” in the name. If you are unsure about a product’s ingredients or the safety, contact the manufacturer.
- Use Silent Spring Institute’s free mobile app, [Detox Me](#), to find simple, research-based tips on how to identify potential sources of toxic chemicals in your home and reduce exposure to toxic chemicals in everyday products.

Reduce dust exposure:

- Keep your home clean and free of dust. Take off shoes at the door, use a damp cloth or mop to eliminate dust, vacuum with a HEPA (high efficiency particulate air) filter, and



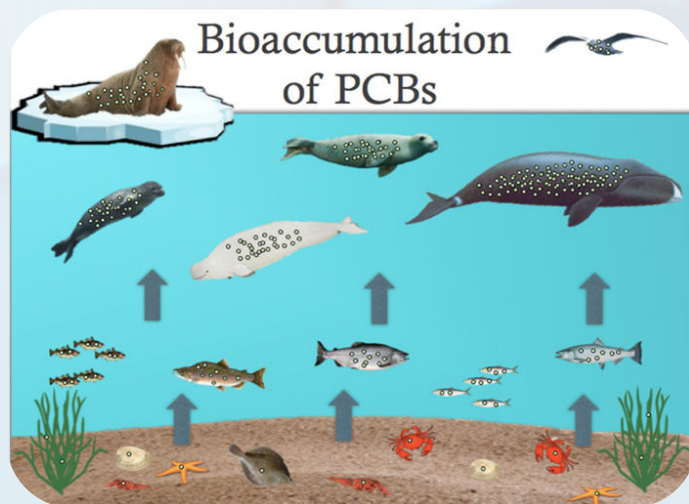
PREVENTING HARM: PERSISTENT ORGANIC POLLUTANTS (POPS)

What Are Persistent Organic Pollutants?

Persistent organic pollutants (POPs) are chemicals infamous for their extreme resistance to breaking down in the environment. POPs are a class of chemical pollutants that are highly hazardous to human health, wildlife and ecosystems and are recognized as a serious global threat.³²⁵

These chemicals have the attributes of being persistent, bioaccumulative and toxic:

- They do not easily break down, and thus stay in the environment for years, even decades. This characteristic is known as **persistence**.
- Many POPs are fat soluble, meaning they build up in fatty tissues of living organisms. This allows them to continue to increase in concentration, or **bioaccumulate**, in the bodies of living organisms over time.
- In turn, these chemicals build up as they move through the food chain, as larger animals absorb the contaminant loads of their food sources – a process known as **biomagnification**.
- Finally, POPs are highly **toxic** to humans, wildlife and the environment at extremely low levels.³²⁶



Source: Alaska Community Action on Toxics (ACAT)

Because of these characteristics, POPs can travel long distances on wind and ocean currents to the Arctic from sources all over the Northern Hemisphere. Over time, these chemicals build up in the environment and in the bodies of fish, wildlife and people.

Some POPs are considered **legacy contaminants**, while newly recognized POPs are known as **emerging contaminants**.

What Are Legacy Contaminants?

Some chemicals that have been banned for decades, such as **dichlorodiphenyltrichloroethane (DDT)** and **polychlorinated biphenyls (PCBs)**, are still present in the environment today. PCBs are a class of chemicals once used to manufacture plastics and used as lubricating fluids in products such as transformers. PCBs are found worldwide in the environment and in human bodies.³²⁷ They are banned in the United States, Northern Europe and globally through the Stockholm Convention on Persistent Organic Pollutants.³²⁸ DDT is an organochlorine insecticide that has been banned for agricultural uses in the U.S. and worldwide through the Stockholm Convention. PCBs and DDT are just two types of legacy contaminants that are of greater concern in the Arctic because they travel north, persist in the environment, and enter the food chain. They remain in the body once absorbed and build up with continued exposure.

What Are Emerging Contaminants?

Emerging contaminants are newer chemicals that have either been more recently regulated, are due to be regulated or are under consideration for regulation. Some emerging POPs include **per- and polyfluoroalkyl substances (PFASs)** and **polybrominated diphenyl ethers (PBDEs)**. There is a growing body of evidence on health effects for emerging POPs, compared to legacy POPs that have been studied for decades.

How Are We Exposed?

POP's build up in wildlife and people of the Circumpolar North.³²⁹ Arctic Indigenous peoples who rely on traditional subsistence foods harvested from the land and sea are particularly vulnerable to exposure to POPs, because the traditional subsistence diet tends to be rich in fats. Some of the fat-rich traditional foods of the Arctic include marine mammals such as bowhead whale and walrus, seal blubber and rendered oils. **Arctic Indigenous peoples have levels of POPs contamination in blood and breast milk that are among the highest of any population on earth, even though most of these chemicals are not manufactured in the Arctic.**³³⁰



Source: Alaska Community Action on Toxics (ACAT)

In Alaska, there are 700 active and inactive military sites throughout the state.³³¹ Many of these sites are sources of POPs and other contaminants such as PCBs, pesticides, heavy metals, solvents, and fuel-related substances. Household products and foods can also be contaminated with POPs. People are exposed to PCBs, DDT and other legacy contaminants by consuming fat-rich foods such as dairy products, fish and marine mammals.³³² Breastfeeding infants can be exposed through breast milk.³³³

There is some evidence that emerging POPs (such as PFASs) tend to behave differently to legacy POPs, in that they bind mainly to protein and less to fat in humans and animals, indicating that different foods (animal meats vs. fats) may have different exposure risks.³³⁴

In multiple studies done in partnership with the people of Sivuaq, Alaska (St. Lawrence Island), research has found that residents of Sivuaq have levels of PCBs in their blood serum about six times higher than levels found in residents of other U.S. states,³³⁵ due to exposure from many sources: global transport, accumulated levels in traditional foods,³³⁶ and in some residents, added exposure



from the military toxic waste site on the Island at Northeast Cape.³³⁷ Another study found residents of Sivuaq had elevated levels of long chain PFASs in their blood serum, likely due to exposure from the traditional diet.³³⁸ This study also found PFASs present in fish species on the Island which suggests that there are many sources of exposure to PFASs. Though traditional foods are a potential route of exposure to contaminants in the Arctic environment, nevertheless they remain **the best source of sustenance for Alaska Native peoples as they are both nutritionally rich and culturally essential.**

Regulations on POPs

The Stockholm Convention on Persistent Organic Pollutants is a living and legally binding treaty created to remove known and potential POPs from global use. The Stockholm Convention has been ratified by 184 nations.³³⁹

Notably, the United States has not ratified the treaty and therefore is not a “Party” to the treaty. This is concerning to Arctic Indigenous Peoples as the Stockholm Convention recognizes the special vulnerabilities of Arctic Indigenous Peoples. In the treaty’s preamble, the Parties “acknowledg[e] that the Arctic ecosystems and indigenous communities are particularly at risk because of the biomagnification of persistent organic pollutants and that contamination of their traditional foods is a public health issue.”³⁴⁰

The 2001 Stockholm Convention identified twelve chemicals known as the “deadly dozen” to be removed from worldwide use. These include DDT, PCBs, dioxins, furans, and the pesticides aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene (HCB), mirex and toxaphene.

The Stockholm Convention is based on the precautionary principle. Its real strength is the inclusion of provisions to add new POPs chemicals that meet scientific criteria for persistence, bioaccumulation, adverse effects and long-range transport.

In 2009, signatories to the treaty agreed to phase out nine additional highly dangerous chemicals, the first time that new chemicals have been added to the original twelve. In 2011, nations agreed to phase out the antiquated insecticide endosulfan. Alaska Community Action on Toxics and other organizations belonging to the International Pollutants Elimination Network (IPEN) were instrumental in ensuring the addition of the nine new chemicals in 2009, endosulfan in 2011, and in May 2019, perfluorooctanoic acid (PFOA), which was added to the list of substances to be eliminated under the 2004 agreement dedicated to reducing POPs.

Body of Evidence on Breast Cancer Risk

The following studies have linked these chemicals to breast cancer risk:

PCBs:

- Certain PCB congeners have been found in human breast tissue of women diagnosed with *in situ* or invasive breast cancer, indicating a link to increased breast cancer risk.^{341, 342}
- In several studies, researchers found that women who regularly ate pike or perch contaminated with PCBs had a higher risk of breast cancer compared to women who never ate these fish.³⁴³
- A meta-analysis of research studies found a significantly increased risk of breast cancer with exposure to two out of three different groupings of PCB congeners: those categorized as potentially anti-estrogenic and immunotoxic (similar to dioxin), and those categorized as more biologically persistent and with enzyme-inducing properties.³⁴⁴
- A recent study of Chinese women found higher total PCB levels in breast fat tissue were associated with more advanced stages of breast cancer.³⁴⁵
- In a study of electrical capacitor production workers with occupational exposures to PCBs, a significant association was found between incidence of breast cancer and exposure to PCBs in non-white women.³⁴⁶



Source: Alaska Community Action on Toxics (ACAT)

DDT:

- The pesticide DDT and its breakdown product DDE have been linked to increased breast cancer risk in several studies. One study found that fetal exposure to DDT or DDE were associated with a fourfold increased risk of breast cancer in adulthood.³⁴⁷
- Another study showed young girls exposed to DDT before the age of 14 had a fivefold increased risk of breast cancer compared to those not exposed or exposed later in life.³⁴⁸

PBDEs:

- A case-control study at the Alaska Native Medical Center confirmed the correlation between serum concentrations of one PBDE congener and breast cancer in Alaska Native women.³⁴⁹
- Some PBDEs have been found to promote estrogenic-like growth of human breast cancer cells in *in vitro* laboratory experiments.³⁵⁰
- Other studies show that PBDEs counteract the anti-cancer effects of the breast cancer treatment drug tamoxifen in cultured breast cancer cells.³⁵¹

PFASs (for more information, see ACAT fact sheet on PFASs):

- Higher risk of breast cancer in Inuit women in Greenland linked to PFOS, PFOA and total PFAS levels.^{352, 353}
- Higher risk of breast cancer in pregnant women in Denmark linked to PFOSA exposure (perfluorooctane sulfonamide, another PFAS compound).³⁵⁴
- Higher risk of estrogen-receptor positive (ER+) tumors in Taiwanese women aged 50 and under associated with exposure to perfluorohexanesulfonic acid (PFHxS) and PFOS.³⁵⁵
- Higher risk of breast cancer in urban Filipinas associated with PFASs.³⁵⁶
- Higher risk of receptor-positive (ER+/PR+) tumors in French women associated with PFOS, while only low levels of PFOS and PFOA were associated with receptor-negative (ER-/PR-) tumors.³⁵⁷ No overall association was found between PFAS levels in blood serum with risk of breast cancer.
- Lower risk of breast cancer among Japanese women with serum concentrations of 20 PFAS congeners. Mixed results were found among postmenopausal women, with some experiencing marginally higher breast cancer risk and others less likely to develop breast cancer, depending on different isomers of perfluorotridecanoic acid (PFTrDA).³⁵⁸
- In mothers in a California study, higher levels of PFOS in maternal blood around the time of giving birth were associated with a lower risk of their daughters developing breast cancer

- before the age of 52. However, when higher maternal levels of one PFOS chemical were combined with higher maternal cholesterol levels, their daughters had a 3.6-times greater risk of breast cancer.³⁵⁹
- In rodent studies, PFOA exposure was associated with delayed mammary gland development,^{360, 361, 362} altered mammary gland development, and disrupted lactation in mothers.³⁶³

Reduce Your Exposure

Here are some ways you can reduce your exposure to POPs:

Breastfeeding:

- We always strongly encourage mothers to breastfeed their babies. Breastmilk contains extremely valuable nutrition for babies and is highly important for healthy growth and development. The research consistently shows that the benefits of breastfeeding generally outweigh any potential risks from chemicals that may be present in breastmilk.³⁶⁴
- In communities at risk of chemical exposures, the benefits of breastfeeding generally still outweigh any potential risks because breast milk can help to reduce any harmful effects of the chemicals on infants.^{365, 366, 367, 368}



Reduce your intake of fats:

- Choose leaner cuts of meat and poultry whenever possible, as some POPs such as PCBs and DDT are stored in the fat of animals.^{369, 370}
- Remove or trim more fat and blubber on meat and fish.
- Consume lesser amounts of rendered oils whenever possible.
- Choose cooking methods that remove excess fat whenever possible, such as broiling, grilling and roasting.
- Consider eating smaller amounts of dairy products or choose low-fat or non-fat dairy products if available.

Check food and water sources near contaminated sites:

- Although it is difficult to determine how far contaminants may spread around formerly used defense sites (FUDS), it is best to test water and traditional food sources close to, downstream or downwind of these sites for the possibility of harmful exposures. If testing is not possible, use sources located further away from FUDS.
- If you have concerns about the safety of your water or traditional foods, contact ACAT or visit our website at www.akaction.org.

PREVENTING HARM: PERSONAL CARE PRODUCTS AND COSMETICS

What Are Personal Care Products and Cosmetics?

Personal care products and cosmetics are products we use on our bodies for hygiene, cleaning, beautifying or changing appearance. These products include dental and oral care, skin care, sun care, hair care, make-up, body care and perfumes.

Chemicals of Concern in Personal Care Products and Cosmetics

Many consumer products on the market contain toxic chemicals that may increase the risk and proliferation (cell multiplication) of breast cancer. Many cosmetics and personal care products contain ingredients that interfere with the normal functioning of the endocrine (hormone) system. These substances are known as endocrine-disrupting chemicals (EDCs). EDCs have been linked to a wide range of adverse health effects including breast cancer.³⁷¹

Some of the EDCs found in cosmetics and personal care products include triclosan, phthalates, octylphenol, parabens, benzophenone, formaldehyde, homosalate, octyl-methoxycinnamate, PABA, and styrene. Evidence from various human and laboratory studies shows that these chemicals may potentially increase the risk of breast cancer.^{372, 373, 374, 375, 376} Fragrance chemicals are exempt from labeling requirements.³⁷⁷ The word “fragrance” in a product ingredient list could mean any combination of 3,059 possible ingredients,³⁷⁸ some of which have known links to breast cancer.

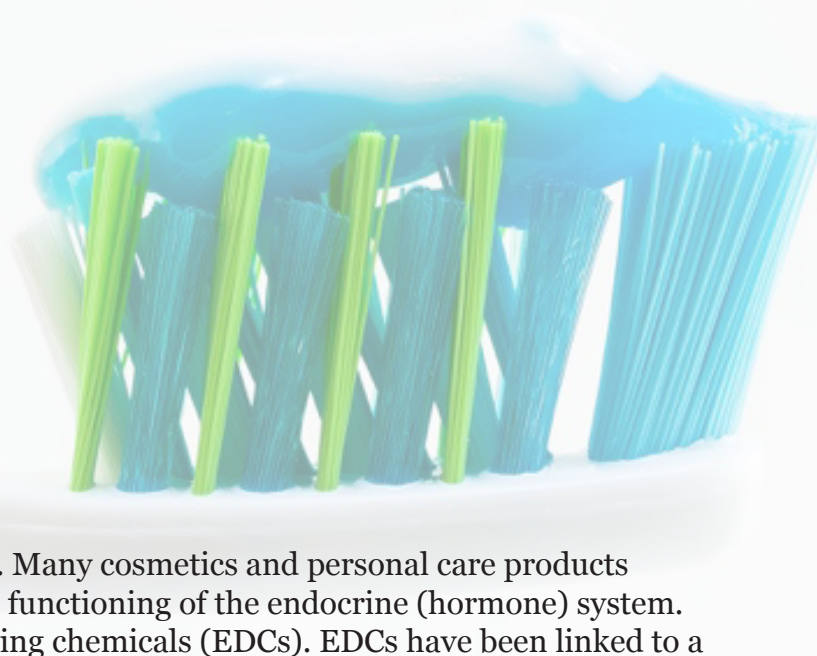
Phthalates are a group of chemicals used in some personal care products and cosmetics. Phthalates are so widely used and ubiquitous in our environment that, in ongoing nationwide biomonitoring studies, they have been found in people of all ages.³⁷⁹ Phthalates may be present in products with the word “fragrance” on the ingredient list.

Triclosan is an antibacterial chemical used in a wide range of consumer products, including soaps, deodorants, cosmetics, cleansers, toothpaste, mouthwashes, acne medications, plastics, fabrics, kitchen utensils, toys and medical devices.^{380, 381} Triclosan is similar in its chemical structure to thyroxine (a thyroid hormone, also known as T4), as well as several other EDCs, including polychlorinated biphenyls (PCBs), diethylstilbestrol (DES) and bisphenol A (BPA).³⁸² In ongoing nationwide biomonitoring studies, triclosan has been found in nearly 75% of people.³⁸³

In 2016, the U.S. Food and Drug Administration restricted use of triclosan and 18 other antiseptic chemicals in over-the-counter hand and body washes.³⁸⁴ This rule does not apply to hand sanitizers, wipes, or products used in health care settings.

How Are We Exposed?

Phthalates are easily absorbed through the skin.³⁸⁵ People can also be exposed through ingestion and inhalation.^{386, 387, 388, 389} Diethyl phthalate (DEP) exposure results mainly from direct use of personal care products such as shampoos, scents, soap, lotions, and cosmetics, and from inhalation of air



containing these chemicals.^{390, 391} DEP is often used to carry fragrances in personal care products, cosmetics, and other consumer products. Exposure to dibutyl phthalate (DBP) is used most commonly in cosmetics, mainly nail polish.^{392, 393, 394} Di-2-ethylhexyl phthalate (DEHP) is used to make plastics flexible in products such as intravenous (IV) and blood storage bags, medical tubing, shower curtains, garden hoses, swimming pool liners, some toys, and packaging film.^{395, 396}

When phthalates enter the body, they are converted into metabolites, or breakdown products.³⁹⁷ Researchers also measure these breakdown products of phthalates in our bodies – those associated with personal care products include monoethyl phthalate (MEP), monomethyl phthalate (MMP), butyl benzyl phthalate (BBP), monobenzyl phthalate (MBzP), and mono(3-carboxypropyl) phthalate (MCPP).

Phthalates are found throughout our indoor environments. Studies have detected phthalates in indoor air and dust,³⁹⁸ and in urine and blood samples of people tested from all ages, from infants to adults.^{399, 400, 401, 402} Phthalates are also found in the amniotic fluid of pregnant women⁴⁰³ and in breast milk,^{404, 405} and can cross the placenta.⁴⁰⁶

Daily exposure to consumer products that contain triclosan is likely the main source of exposure for the U.S. population.⁴⁰⁷ Several companies that make toothpaste and other products containing triclosan claim that the active ingredient continues to work for up to 12 hours following use. This means that consumers are exposed to triclosan long after the few minutes it takes to brush their teeth or use other products containing the ingredient.⁴⁰⁸ Triclosan can be absorbed through the skin, mouth and nose.^{409, 410} Triclosan has also been found in the breast milk and plasma of breastfeeding mothers.⁴¹¹

Body of Evidence on Breast Cancer Risk

Evidence of the potential harmful effects of phthalates and triclosan has been building over recent years. Strong evidence from human, animal and *in vitro* (cell) studies shows that phthalates and triclosan are considered EDCs.⁴¹² EDCs can act like hormones or interfere with normal functioning of the hormone system, which can then negatively affect our health. EDCs may also increase or decrease the levels of hormones in our blood.⁴¹³ Many EDCs have non-linear effects in the body, meaning there is not necessarily greater risk with greater exposure. Lower doses may have greater adverse effects than higher doses. Sometimes the timing of exposure determines the potential effect – whether exposure occurs *in utero*, during infancy, puberty, or later in life.

The evidence from epidemiologic (human) studies linking these chemicals to breast cancer risk is still mixed – some studies have found that exposure to these chemicals increases the risk of breast cancer (positive association), while others have found that exposure protects against breast cancer (negative association) or is not associated. More studies need to be done to understand the relationship between



exposure and disease; nevertheless, we know enough to take precautions against potentially harmful exposures.

The following studies have linked phthalates to breast cancer risk:

- In a study of Alaska Native women, MEHP was associated with increased risk of breast cancer, but no association with other phthalate metabolites was found.⁴¹⁴
- A study on breast cancer risk in women of northern Mexico found that higher urinary levels of MEP were associated with increased risk of breast cancer.⁴¹⁵ This association was twice as high in premenopausal women. However, this study also found that urinary levels of MBzP and MCPP were associated with a decrease in breast cancer risk.
- In a multiethnic study, women with the highest urinary levels of DEHP metabolites had an increased risk of developing breast cancer, and this effect was highest in Native Hawaiian women.⁴¹⁶
- A large, prospective study on urinary levels of 13 phthalate metabolites and postmenopausal breast cancer found no association between breast cancer risk and phthalate exposure.⁴¹⁷
- Another human study found increased levels of MMP were associated with early breast development in healthy adolescent girls before age eight,⁴¹⁸ a known risk factor for breast cancer.⁴¹⁹
- Animal studies have shown that abnormalities in mammary tissue development were found in very young rats exposed to BBP,⁴²⁰ as well as those exposed *in utero*.⁴²¹
- *In vitro* studies have shown that BBP and DBP trigger proliferation of breast cancer cells, malignant invasion, and formation of tumors of a certain type of breast cancer (receptor-negative breast cancer).^{422, 423} Another *in vitro* study found BBP promotes breast cancer stem cell growth.⁴²⁴
- Another *in vitro* study found DEHP exposure increased the proliferation of human breast cancer cells by interfering with the progesterone receptor system.⁴²⁵

Triclosan is known to interfere with normal breast development and health. Triclosan interferes with the endocrine system in a complex combination of ways that result in stimulating and/or blocking the effects of the estrogen and androgen hormones in the body.^{426, 427, 428, 429, 430} Even at very low doses, such as the levels commonly found in the environment that people are exposed to daily, triclosan has also been found to enhance the growth and proliferation of cultured breast cancer cells in laboratory studies.^{431, 432} Triclosan has also been associated with early onset of puberty, another breast cancer risk factor.⁴³³



Reduce Your Exposure

Here are some ways you can reduce your exposure to contaminants in personal care products and cosmetics:

- Avoid products with toxic ingredients whenever possible. Check ingredient lists and avoid products listing “fragrance” or phthalates. It is best to use products with shorter ingredient lists or with ingredients you can easily recognize and pronounce.
- Research the ingredients of your personal care products, beyond what is on the label. Check out EWG’s Skin Deep® database at <https://www.ewg.org/skindeep> for a more complete listing.
- Use Silent Spring Institute’s free mobile app, *Detox Me*, to find simple, research-based tips on how to identify potential sources of toxic chemicals in your home and reduce exposure to toxic chemicals in everyday products.
- Choose products from companies that have signed the Compact for Safe Cosmetics. For a listing, check out www.safecosmetics.org
- Avoid antibacterial and antimicrobial products, except when necessary and/or required. Keep hands clean with soap and warm water instead.
- Wash hands often, especially when handling food, before you eat, after using the bathroom, or when you are around someone who is sick.
- Wash children’s hands and toys often.
- Since triclosan is required to be listed on the label in personal care products, make sure to read the list of ingredients before buying. Check labels for “active ingredients” like triclosan. Triclosan may be present in products using the trade names Microban, Irgasan, Lexol, Ster-Zac, Cloxifenolum, and Biofresh.
- Lemon essential oil and grapefruit seed extract have natural antimicrobial properties and are included in some soaps.



PREVENTING HARM: PESTICIDES

What Are Pesticides?

Pesticides are substances used to repel, incapacitate (paralyze) or kill unwanted pests. Since the end of World War II, synthetic pesticides have become widespread in agriculture and general pest removal.⁴³⁴ Many of these chemicals are endocrine disruptors and carcinogens linked to breast cancer and other harmful health effects.

Pesticides are commonly used in both industrial and residential settings. Used in large-scale agriculture, pesticides are often sprayed on produce throughout the growing period and can contaminate food items purchased in local grocery stores. Pesticides are also used around the house to deter pests from lawns and gardens, or eliminate pests inside the home. Pesticide products are often used by municipal governments, cities and business owners to prevent pests from accessing outdoor spaces.

How Are We Exposed?

The three common ways that pesticides can enter the human body are contact on the skin, ingestion through the mouth, and inhalation into the lungs (see *Figure 1*).⁴³⁵

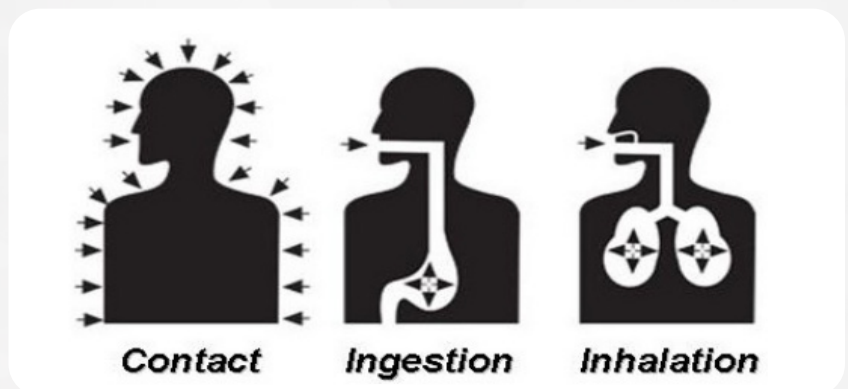


Figure 1. Pesticide exposure pathways

Body of Evidence on Breast Cancer Risk

Multiple studies have found that women who live near areas of pesticide use are at a significantly higher risk for breast cancer. Studies in Iowa and North Carolina found an increased risk of breast cancer among farmers' wives living closer to areas of pesticide application.⁴³⁶ A study in Brazil found that women living near plantation areas with pesticide application were 2.37 times more likely to develop breast cancer.⁴³⁷ Another study in Western Australia found a 43 percent increased risk of breast cancer in women who had ever noticed pesticide spray drift, compared to women who had never noticed pesticide spray drift.⁴³⁸



Timing of exposure is also an important factor in future breast cancer risk. Exposure to pesticides at a younger age significantly increases the risk of developing breast cancer later in life.^{439, 440, 441, 442, 443, 444} There is also evidence that ancestral exposure to DDT (dichlorodiphenyltrichloroethane), a pesticide banned since 1972 (with exceptions for allowable uses to control malaria), may increase risk factors for breast cancer in current and future generations.⁴⁴⁵

Studies also suggest that being exposed to mixtures of different pesticides may alter risk for breast cancer and other diseases compared to being exposed to individual pesticides.^{446, 447, 448, 449}

Reduce Your Exposure

- **Advocate for policies to ban toxic pesticides.** To address the root cause of pesticide exposure in our communities, we must ban toxic pesticides from being manufactured and used in the first place. Contact your representatives about this issue.
- **Control indoor pests using natural, non-toxic methods.** For tips and tricks on safe and effective methods of dealing with pests common to Alaska (including ants, bedbugs, cockroaches, fleas, flies, mice, rats, moths and weeds), visit [Pesticide Action North America](#) and the [Northwest Center for Alternatives to Pesticides](#).
- **Avoid using chemical fertilizers and pesticides.** Opt to use alternative pest management systems, such as improving soil health, planting catch crops, creating the conditions for organisms that fight pests to thrive, breeding plants for pest tolerance, and using crop rotation and companion planting techniques.⁴⁵⁰
- **Wear personal protective equipment (PPE).** If you use pesticides or are near an area being sprayed or that was recently sprayed, wear PPE such as fitted gloves, boots, hats, long-sleeved shirts, coveralls, eye protection and masks.⁴⁵¹ Garments made from synthetic materials may provide more protection from pesticides than cotton garments.⁴⁵²
- **Reduce consumption of fats.** Many pesticides are stored in the fat of animals, so reducing your fat intake will reduce your exposure to these pesticides:^{453, 454, 455}
 - Choose leaner cuts of meat and poultry whenever possible.
 - Remove or trim more fat and blubber on meat and fish.
 - Consume lesser amounts of rendered oils whenever possible.
 - Choose cooking methods that remove excess fat whenever possible, such as broiling, grilling and roasting.
 - Consider eating smaller amounts of dairy products, or choose low-fat or non-fat dairy products if available.
- **Purchase produce with lower levels of pesticides.** The Environmental Working Group (EWG) analyzes data on levels of pesticides found in non-organic produce in the U.S. and uses this information to rank foods with the highest and lowest levels of pesticides. Choose foods on the [Clean Fifteen](#)[™] list, and avoid foods on the [Dirty Dozen](#)[™] list or eat them less often. For more information, visit EWG's [Shopper's Guide to Pesticides in Produce](#)[™].
- **Buy organic produce.** Organic foods can be more expensive and may not be as widely available, but whenever possible, choose USDA-certified organic produce because it contains lower levels of pesticides and other chemicals.⁴⁵⁶
- **Wash produce.** Always thoroughly wash produce before eating. First, wash your hands with warm water and soap. Then gently rub the surface of the produce as you hold it under running water, using a clean brush to scrub tougher produce like potatoes. Then dry the produce with a clean cloth or paper towel. Finally, wash your hands again with warm water and soap.⁴⁵⁷
- **Learn about your home.** Find out if pesticides have been used in your home. For example, check whether your home was ever treated with aldrin/dieldrin to control termites.⁴⁵⁸
- Avoid tick and flea collars that contain toxic pesticides, such as chlorpyrifos.⁴⁵⁹

PREVENTING HARM: TRADITIONAL FOODS, DIET AND NUTRITION

All About Traditional Foods, Diet and Nutrition

Maintaining a traditional diet and continuing to hunt, fish and gather traditional foods is essential to the physical, cultural, social, spiritual, and economic wellbeing of Arctic Indigenous Peoples. Though traditional foods are a potential route of exposure to contaminants in the Arctic environment, nevertheless they remain **the best source of sustenance for Alaska Native peoples as they are both nutritionally rich and culturally essential.**

Subsistence foods are extremely health protective and nutrient-rich (containing critical nutrients such as folic acid, vitamin C, vitamin D, iron and zinc), high in protein, fat (particularly omega-3 fatty acids) and antioxidants, and low in carbohydrates. In contrast, store-bought, processed foods may have limited nutritional value and possibly also contain harmful chemicals such as pesticides, preservatives, and other substances that may be hazardous to health. Research shows that changes in diet from traditional foods to highly processed foods may have adverse health implications, including an increase in diabetes and heart disease among people of the Arctic, as well as possible declines in mental health and well-being.⁴⁶⁰



Photo by Samarys Seguinot-Medina

Chemicals of Concern in Traditional Foods

Persistent organic pollutants (POPs) are a class of chemicals known for their extreme resistance to breaking down in the environment. These chemicals are known to be highly hazardous to human health, wildlife and ecosystems and are recognized as a serious global threat.⁴⁶¹

POPs have the attributes of being persistent, bioaccumulative and toxic (*for more information, see ACAT fact sheet on POPs*).⁴⁶² Because of these characteristics, POPs build up in concentration over time in the environment and have been found in the bodies of fish, wildlife and people of the Circumpolar North.⁴⁶³ Most POPs contaminants build up in fatty tissue and thus can be found in high concentrations in the fat-based Arctic food web.

Some POPs chemicals of concern in Arctic traditional foods include:

Polychlorinated biphenyls (PCBs) are a class of chemicals used to manufacture plastics and used as lubricating fluids in products such as transformers. PCBs are found worldwide in the environment and in human bodies.⁴⁶⁴ They are banned in the United States, Northern Europe and globally through the Stockholm Convention on Persistent Organic Pollutants.⁴⁶⁵

DDT (dichlorodiphenyltrichloroethane) is an organochlorine insecticide that has been banned for agricultural uses in the U.S. and worldwide through the Stockholm Convention.

Mercury and related compounds are potent neurotoxins that can cause serious, long-term, harmful health effects in humans, especially young children. Mercury pollution in the Circumpolar North, including Alaska, comes primarily from emissions from Asian industry and other global sources that travel to the Arctic on air and ocean currents.⁴⁶⁶ Once mercury enters the water system and converts to the absorbable form of **methylmercury**, it can build up in fish, wildlife and people.

Per- and Polyfluoroalkyl Substances (PFASs) are chemicals used in water-resistant and waterproof products, non-stick cookware, stain-resistant fabrics, grease-proof food packaging, and in aqueous film forming foam (AFFF) used to put out fires associated with jet fuel. *(For more information, see ACAT fact sheet on PFASs).*

Polybrominated diphenyl ethers (PBDEs) are a class of brominated flame retardants associated with breast cancer. PBDEs are added to many consumer products such as electronics, furniture foams, fabrics, kitchen appliances, and upholstery in furniture, mattresses and car seats.⁴⁶⁷ Concentrations of PBDEs have grown over the years in marine mammals.⁴⁶⁸

How Are We Exposed?

Arctic Indigenous Peoples who rely on traditional subsistence foods harvested from the land and sea are particularly vulnerable to exposure to POPs, because the traditional subsistence diet tends to be rich in fats.

People are exposed to many POPs by consuming fat-rich foods such as dairy products, fish and marine mammals.⁴⁶⁹ Breastfeeding infants can be exposed to POPs through breast milk.⁴⁷⁰ Arctic Indigenous Peoples have levels of POPs concentrations in blood and breast milk that are among the highest of any population on earth, even though most of these chemicals are not manufactured in the Arctic.⁴⁷¹ Though traditional foods are a potential route of exposure to contaminants in the Arctic environment, nevertheless they remain **the best source of sustenance for Alaska Native peoples as they are both nutritionally rich and culturally essential**. Many Alaska Native communities still feel the benefits of consuming traditional foods outweigh the risks.



Photo by Sarah Petras

In Alaska, there are 700 active and inactive military sites throughout the state.⁴⁷² Many of these sites are sources of POPs and other contaminants such as PCBs, pesticides, heavy metals, solvents, and fuel-related substances. People living in Alaska may also be exposed to POPs from these contaminated sites.

eggs^{489, 490} freshwater fish, seals, polar bear and reindeer.⁴⁹¹

PBDE exposure via dietary sources has been studied extensively in recent years. The primary routes of exposure to PBDEs are inhalation, hand-to-mouth contact and absorption through the skin.⁴⁹² PBDE-contaminated dust may be ingested when present on hands and food while eating.^{493, 494, 495, 496, 497}

Contaminated foods are also a source of PBDE exposure.⁴⁹⁸ People may be exposed from eating fatty foods such as meat, fish, marine mammals and dairy products.^{499, 500} People of the Arctic may experience an even higher risk of exposure due to their traditional diet rich in fat from marine mammals and other sources.⁵⁰¹

PBDEs have been found in mothers' breast milk and in the blood of mothers and their babies.^{502, 503, 504, 505} Because PBDEs are highly fat soluble, they build up in breast milk and can be a major source of exposure for breastfed infants.^{506, 507} Some PBDEs can pass from mother to fetus during pregnancy through the placenta.⁵⁰⁸

Body of Evidence on Breast Cancer Risk

Some nutritional factors that may protect against breast cancer include:

- Higher levels of circulating **carotenoids** (plant-based nutrients that are converted into vitamin A in the body) in women were linked with protection against breast cancer.⁵⁰⁹ The best sources of carotenoids are yellow and orange fruits and vegetables such as apricots, carrots, winter squashes and sweet potato, as well as dark leafy green vegetables.⁵¹⁰
- Studies also show that consumption of **whole soy foods and fermented soy products** (such as tempeh and miso, as found in traditional Asian diets; not to be confused with heavily processed soy products found in the United States) are linked with lowered risks of breast cancer.⁵¹¹



photo by Jeff Chen / Nenana, AK

Methylmercury builds up in muscle tissue of certain fish and marine mammals⁴⁷⁸, and exposure may happen from eating large, predatory fish, marine mammals, and wildlife at the top of the aquatic food chain such as polar bears.^{479, 480, 481} Mercury contamination in Alaska fish compelled the State of Alaska to issue fish consumption advisories for the first time in 2007,⁴⁸² and again in 2014,⁴⁸³ restricting consumption of certain fish for women who are or can become pregnant, nursing mothers, and children age 12 and under. **All species of wild Alaska salmon are very low in mercury levels, so salmon is not a major source of mercury exposure.**⁴⁸⁴ (*Other recommendations regarding fish consumption follow at the end of this fact sheet.*)

Maternal body burdens of methylmercury may also be passed to fetuses through the placenta and to nursing infants through breastmilk.^{485, 486, 487}

The Arctic Monitoring and Assessment Program reports **PFASs** have been detected in Arctic marine biota, including seabirds⁴⁸⁸ and their



- Research shows that higher levels of **vitamin D** may protect some women from developing breast cancer, although the data are inconsistent and inconclusive. One study found that postmenopausal women who took supplements of calcium plus vitamin D had a reduced risk of ductal carcinoma *in situ* (DCIS) of the breast.⁵¹² Another study of young Alaska Native women found that consumption of traditional marine foods decreased significantly from the 1960s through the 1990s and was also associated with a decline in levels of serum vitamin D.⁵¹³ Given that many people have vitamin D deficiency or insufficient levels of vitamin D, supplementation may be warranted.⁵¹⁴
- Diets **lower in red meats** during adolescence also show a decreased risk of later development of breast cancer.⁵¹⁵
- It is especially important to aim for **lean meats** when eating meat, as environmental chemicals such as PCBs and DDT are stored in the fat of animals.^{516, 517}

Some nutritional factors that may be linked to breast cancer include:

- Diets **high in omega-6 fatty acids** (such as those from vegetable oils and processed foods) and low in omega-3 fatty acids (found in wild fish, walnuts and flaxseeds) have been linked to higher risk of breast cancer.⁵¹⁸
- **Methylmercury** is linked to growth of breast cancer cells.⁵¹⁹
- Finally, there is strong evidence that **consuming alcohol** is linked to breast cancer risk, with numerous studies showing that each additional 10 grams of alcohol per day is linked to a 9% increased risk.⁵²⁰

Reduce Your Exposure

Here are some ways you can boost your nutrition and reduce your exposure to contaminants through your diet:

Breastfeeding:

- We always strongly encourage mothers to breastfeed their babies. Breastmilk contains extremely valuable nutrition for babies and is highly important for healthy growth and development. The research consistently shows that the benefits of breastfeeding generally outweigh any potential risks from chemicals that may be present in breastmilk.⁵²¹
- In communities at risk of chemical exposures, the benefits of breastfeeding generally still outweigh any potential risks because breast milk can help to reduce any harmful effects of the chemicals on infants.^{522, 523, 524, 525}

Eat smart to reduce your exposure:

- Avoid processed and packaged foods. Food packaging may contain PFASs. To lower your risk, limit your consumption of prepackaged products in fast food containers, pizza boxes, or microwave popcorn bags.
- As much as possible, avoid canned foods and choose fresh or frozen foods.
- Parents are strongly encouraged to ensure their children have healthy diets consisting of a variety of fruits and vegetables, organic whenever possible, especially in families with a history of breast cancer. Try to include sources of omega-3 fatty acids (such as fish, walnuts and flaxseeds) and limit consumption of red meat, vegetable oils, processed foods and alcohol.

Reduce your intake of fats:

- Choose leaner cuts of meat and poultry whenever possible, as some POPs such as PCBs and
- DDT are stored in the fat of animals.^{526, 527}
- Remove or trim more fat and blubber on meat and fish.
- Consume lesser amounts of rendered oils whenever possible.
- Choose cooking methods that remove excess fat whenever possible, such as broiling, grilling and roasting.
- Consider eating smaller amounts of dairy products or choose low-fat or non-fat dairy products if available.

Reduce exposure to mercury:

- Eat fish with lower mercury levels, such as all species of wild Alaska salmon.⁵²⁸ The Alaska Department of Health and Social Services, Division of Public Health (DPH) last updated its recommendations for safe fish consumption in 2014.⁵²⁹ The most recent guidance from DPH recommends eating as much as you want of all species of wild Alaska salmon, as well as 18 other fish (*see Figure 2*).
- When eating ocean fish, consider eating smaller, younger fish whenever possible, as older fish tend to build up more mercury over time.⁵³⁰ The DPH recommends eating less of fish which are known to have high mercury levels and suggests consumption limits for these species. Figure 2 outlines a point system in which people can eat up to 12 points per week (the safe species get zero points), with points based on six-ounce portions. **Please keep in mind that the State of Alaska fish consumption guidelines are based on unrealistically low daily estimates of the amounts of fish that people might actually eat each day.** We urge even greater precaution to avoid those species that tend to accumulate mercury or other persistent chemicals. Alaska's "Fish Consumption Rate" is currently listed as 6.5 grams of fish per person per day (about the size of a small strawberry). We also recommend that the State of Alaska adjust their fish consumption

rate to a more realistic 175 grams/person/day in order to ensure protection of our waters and health.

Check food and water sources near contaminated sites:

- Although it is difficult to determine how far contaminants may spread around formerly used defense sites (FUDS), it is best to test water and traditional food sources close to, downstream or downwind of these sites for the possibility of harmful exposures. If testing is not possible, use sources located further away from FUDS.
- If you have concerns about the safety of your water or traditional foods, contact ACAT or visit our website at www.akaction.org.
- Drinking water contaminated with PFASs is a primary route of PFAS exposure. Public drinking water supplies can be contaminated with PFASs, as well as local surface or groundwater sources. To find out if PFASs are present in your water supply, contact your local water department or local health department to discuss PFAS levels.

Food preparation and storage tips:

- Cook using stainless steel or cast iron to avoid exposure to PFASs in non-stick cookware.
- Avoid storing and microwaving food in plastic. Use glass, ceramic or stainless-steel containers instead.
- Use stainless-steel or cast-iron cookware. Avoid cookware treated with stick-resistant coatings (e.g., Teflon™).

Figure 2. Fish consumption guidelines for Alaskans. Source: Alaska Department of Health and Social Services, Division of Public Health (DPH)

Eating Fish Safely

Guidelines for Alaska Women and Children

Mix and match your fish meals for up to:

12 POINTS PER WEEK

Note: A **meal size** is 6 ounces, uncooked weight (or roughly the size of a deck of cards).

Alaska fish is rich in nutrients and good for you. State health officials recommend that everyone eat fish at least twice per week. However, all fish contain some mercury, a toxic metal that can harm the developing nervous systems of unborn babies and children. Because of this, women who are or can become pregnant, nursing mothers and children should follow these guidelines to limit their mercury intake. Everyone else can eat as much seafood as they like.

PER MEAL
0
Points

Unrestricted amounts

Arctic Cisco	Pacific Ocean Perch
Big Skate	Rainbow Trout
Black Rockfish	Rougheye Rockfish
Broad Whitefish	Sablefish
Dolly Varden	Salmon, Chinook (King)
Dusky Rockfish	Salmon, Chum
Grayling	Salmon, Pink
Halibut <40 pounds	Salmon, Red (Sockeye)
Humpback Whitefish	Salmon, Silver (Coho)
Least Cisco	Sheefish
Lingcod <35 inches	Walleye Pollock
Pacific Cod	

PER MEAL
3
Points

Halibut 40–80 pounds
Lake Trout
Lingcod 35–40 inches

PER MEAL
4
Points

Halibut 80–140 pounds
Lingcod 40–45 inches
Longnose Skate

PER MEAL
6
Points

Yelloweye Rockfish
Halibut 140–220 pounds

PER MEAL
12
Points

Halibut >220 pounds
Lingcod >45 inches
Salmon Shark
Spiny Dogfish

Eat a **variety** of fish and other seafood as part of a balanced diet.



For more information, go to:
www.epi.hss.state.ak.us/
or call (907) 269-8000



ASSESSING ENVIRONMENTAL EXPOSURES

Screening your patient’s environmental health history is an important part of determining a correct diagnosis. Some symptoms of environmental exposures are very common and may be mistaken for symptoms of many other diseases and disabilities.^{531, 532} It is critical to ask the right questions to determine if your patient has been exposed to a chemical of concern. This Environmental Health History and Assessment Form will help you determine if your patient may have a health effect from an environmental exposure.^{533, 534, 535, 536}

Environmental Health History and Assessment Form	
Patient Name:	Date:
Clinic:	Location:
GENERAL HOUSING	
Where do you live and spend most of your time?	
INDOOR HOME ENVIRONMENT <i>See ACAT fact sheets: PFASs in Household Consumer Products; Occupational Exposures; Personal Care Products and Cosmetics; Pesticides</i>	
What is the main way that you heat the home or camp where you live now?	
Do you use pesticides (including mosquito repellents, chemical bug traps, or lice and scabies treatments)?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not sure If yes, which types of pesticides or specific products do you use?
Where do you keep household cleaners and other chemicals?	
Please tell me all the chemicals and hazardous materials that you use in your home (Examples: cleaning products, solvents, glue, paint strippers, Clorox bleach, Pine Sol, air fresheners, bathroom and tile cleaners for mold and mildew, gasoline and other petroleum products, mosquito repellents/bug spray and other pesticides, stain protectors for furniture, lead, etc.)	
Please tell me all the chemicals and toxic materials that you use at your camp (Examples: gasoline and other petroleum products, mosquito repellents and other pesticides, etc.)	

TOXIC CHEMICAL EXPOSURES See ACAT fact sheets: *Persistent Organic Pollutants (POPs); Occupational Exposures*

Is your home or camp near a hazardous waste site (such as a formerly used defense site, current or past mine, etc.), landfill or burn box?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not sure If yes, location:
Please tell me all the chemicals and toxic materials that you use at work. (Examples: cleaning products, solvents, glue, paint strippers, Clorox bleach, gasoline and other petroleum products, varnish and marine paints, mosquito repellents/bug spray and other pesticides, lead, mercury, other metals, welding materials, etc.)	

FOOD AND WATER CONTAMINATION See ACAT fact sheets: *Traditional Foods, Diet and Nutrition; Persistent Organic Pollutants (POPs)*

What is the major source of drinking water in the home or camp where you live now? Are any of these water sources located near contaminated site(s) of concern?	<input type="checkbox"/> Well water <input type="checkbox"/> Bottled water <input type="checkbox"/> Community water <input type="checkbox"/> Other: _____
What other sources of drinking water do you use, including camping sites?	
Describe your traditional foods diet. What kinds of foods do you eat? (Examples: greens, berries, walrus, whale, seal, moose, reindeer, caribou, seal oil, medicinal plants and roots, etc.)	How much traditional foods do you eat? How often? From where?
Do you wash fruits and vegetables before eating them or preparing meals?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not sure

OCCUPATIONS AND HOBBIES See ACAT fact sheet: *Occupational Exposures*

Where do you work?	
Where do other adults in your household work?	
Do any adults in your household work around toxic chemicals? (Examples: glues, solvents, polish, fuels, chemicals associated with mining and oil development, etc.)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not sure

If so, do they shower and change clothes before returning home from work?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not sure
Do you or any family member have arts, crafts, ceramics, or similar hobbies?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not sure
HEALTH-RELATED QUESTIONS	
Do you have any symptoms that might be related to an environmental exposure?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not sure If yes, when do you notice your symptoms the most? What causes the symptoms to start? What causes them to stop?
Are family members, neighbors and/or co-workers having the same symptoms?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not sure
Do you have symptoms that are frequent or recurring like cough, headaches, fatigue, blood in urine or stool, or unexplained pain?	<input type="checkbox"/> Cough <input type="checkbox"/> Fatigue <input type="checkbox"/> Headaches <input type="checkbox"/> Blood in urine <input type="checkbox"/> Blood in stool <input type="checkbox"/> Unexplained pain <input type="checkbox"/> Other: _____
FOLLOW-UP QUESTIONS	
Are there environmental health concerns in your community, job, child's school or childcare setting?	
Can you think of any way you might have been exposed to something harmful?	



Source: Alaska Community Action on Toxics

ADDITIONAL RESOURCES ON BREAST CANCER AND ENVIRONMENTAL HEALTH

Alaska Run for Women

www.akrffw.org

The mission of the Alaska Run for Women is, “To raise money for and awareness of breast cancer and women’s health, and to showcase the talents of Alaska’s women athletes.” This is accomplished through an annual women’s run/walk event that serves as a vehicle for fundraising, participation, awareness and competition, and grant making to organizations concerned with breast cancer research, education, outreach, prevention and early detection. Since 1993, \$5.2 million in cash and donated mammograms has been generated by the event – all of which has been distributed to organizations associated with breast cancer. The donated mammograms are given to low-income women through a program administered by a local non-profit.

Alaska Community Action on Toxics

www.akaction.org

Alaska Community Action on Toxics (ACAT) is a statewide environmental health and justice organization established in 1997. We believe everyone has the right to clean air, clean water, and toxic-free food. Driven by a core belief in environmental justice, ACAT empowers communities to eliminate exposure to toxics through collaborative research, shared science, education, organizing, and advocacy. We help communities implement effective strategies to limit their exposure to toxic substances and to protect and restore the ecosystems that sustain them and their way of life. We work to eliminate the production and release of harmful chemicals by industry and military sources, ensure the public’s right-to-know, achieve policies based on the precautionary principle, and support the rights of Indigenous peoples.

- Opinion Editorial: “Breast Cancer, Chemicals and Environmental Justice.” *Juneau Empire*, 1 July 2020. By Samarys Seguinot-Medina, DrPH, MSEM, ACAT Environmental Health Program Director.
<https://www.peninsulaclarion.com/opinion/opinion-breast-cancer-chemicals-and-environmental-justice/>
- Map: *Villages and Federal Defense Facilities in the Norton Sound Region, Alaska*
<https://www.akaction.org/media-center/maps/>
- Film: *I Will Fight Until I Melt (Whanga Pillugaghllleqqa Kenlanga Ughullemmun)*
www.akaction.org/our_story/history/

This short documentary film features an interview with Community Health Aide & Yupik elder Annie Alowa (1924-1997) from the village of Savoonga on Sivuqaq (St. Lawrence Island). The film demonstrates her concerns about the environmental and health effects of a Cold War-era military site built on her island at Northeast Cape, and presents a call for others to respond to her concerns about the impact of contaminants on human health. Annie died of cancer in February 1999. She attributed her cancer, as well as the cancers of others who live on Sivuqaq, to the military poisoning of Northeast

Cape. Annie Alowa's life inspires all of Alaska Community Action on Toxics' mission-based work and projects.

- Poster: *Protecting Our Health in Alaska*

https://www.akaction.org/tackling_toxics/body/preventive_medicine/

This ACAT poster illustrates sources of contamination common in rural Alaska villages, such as burn boxes, persistent organic pollutants (POPs), formerly used defense sites (FUDS), and traditional foods, and describes measures to reduce exposure to contaminants. Order copies for clinics and homes by contacting ACAT.

- Alaska Collaborative on Health and the Environment (CHE-Alaska)

www.akaction.org/tackling_toxics/alaska/CHE-AK/

CHE-Alaska was established by ACAT in 2006 to address growing concerns about the links between human health and environmental factors. CHE-Alaska sponsors free monthly statewide teleconference seminars with Alaskans and nationally renowned scientists, health care professionals, and policy experts who are working on a range of environmental health and justice concerns.

Alaska Community Health Aide Program

<https://akchap.org>

The Alaska Community Health Aide Program (CHAP) consists of a network of approximately 550 Community Health Aides/Practitioners (CHA/Ps) in over 170 rural Alaska villages. CHA/Ps assess and provide emergent, acute and chronic care to residents of their respective communities and are the front line of healthcare in their communities.

Breast Cancer Action

www.bcaction.org

Breast Cancer Action's mission is to achieve health justice for all women at risk of and living with breast cancer.

Breast Cancer Action focuses on systemic interventions that will address the root causes of the disease and produce broad public health benefits. These benefits will ensure that fewer women develop breast cancer and die from breast cancer and no community bears a disproportionate burden of diagnosis or death from this disease. BCAction is a source for accurate, evidence-based, unbiased information that allows those of us living with breast cancer to make well-informed medical decisions.

- Toolkit to Navigate Breast Cancer

<https://bcaction.org/guidetonavigatingbreastcancer/>

A breast cancer diagnosis can be frightening and confusing. The free *Toolkit to Navigate Breast Cancer* is a resource to help anyone who has been newly diagnosed, as well as their caregivers, to learn about their options and partner effectively with their providers to choose the treatment that is best for them. The Toolkit is comprised of two parts: *What You Need to Know About Breast Cancer*, and *Tools and Tips for a New Breast Cancer Diagnosis*.

- Think Before You Pink®

<https://thinkbeforeyoupink.org>

Think Before You Pink®, a project of Breast Cancer Action, launched in 2002 in response to the growing concern about the overwhelming number of pink ribbon products and promotions on the market. The campaign calls for more transparency and accountability by companies

that take part in breast cancer fundraising and encourages consumers to ask critical questions about pink ribbon promotions.

Breast Cancer and the Environment Research Program (BCERP)

<https://bcerp.org/>

The Breast Cancer and the Environment Research Program (BCERP) is a joint effort co-funded by the National Institute of Environmental Health Sciences (NIEHS) and the National Cancer Institute. The BCERP supports a multidisciplinary network of scientists, clinicians, and community partners to examine the effects of environmental exposures that may predispose a woman to breast cancer throughout her life. The BCERP aims to examine windows of susceptibility that could be informative, especially considering novel findings of the effects of diet, hormone replacement therapy, and long-term exposure to agents such as endocrine disruptors in adults, as well as children.

- *Educational materials for health professionals*

<https://bcerp.org/educational-materials/materials-for-health-professionals/>

The BCERP offers materials for health professionals to assist in discussing with patients ways to lower their risk of developing breast cancer. Health professionals are encouraged to use these materials to guide discussions with female patients, their parents, or caregivers about steps they can take now that may lower their risk, or their daughters' risk, of developing breast cancer when they become adults. Parents and caregivers are also encouraged to share this information with their health providers. Most of the materials are in a format that can be adapted to suit different populations.

Breast Cancer Prevention Partners

www.bcphp.org/

For over 25 years, Breast Cancer Prevention Partners (formerly Breast Cancer Fund) has been the leading science-based policy and advocacy organization working to prevent breast cancer by eliminating our exposure to toxic chemicals and radiation. BCPP's focus is on the intersection of breast cancer prevention and environmental health.

- *State of the Evidence: The Connection between Breast Cancer and the Environment*. By Janet Gray, PhD. 2017. Published by Breast Cancer Prevention Partners.

www.bcphp.org/resource/state-evidence-2017/

In this review, published in the journal *Environmental Health*, Breast Cancer Prevention Partners examines the continually expanding and increasingly compelling data linking radiation and various chemicals in our environment to the current high incidence of breast cancer.

- Glossary of Breast Cancer Exposures

<https://www.bcphp.org/science-policy/glossary-of-exposures/>

Fact sheets with summaries of current science connecting the exposures with the strongest evidence linked to breast cancer, as well as who is most vulnerable and how to avoid the exposure.

Environmental Working Group (EWG)

www.ewg.org

EWG's team of scientists, policy experts, lawyers and communications and data experts work tirelessly to reform our nation's broken chemical safety and agricultural laws. EWG pushes industries to adopt standards that protect our health and environment, stands against chemicals of concern, educates consumers with actionable information and inspires demand for safer products.

- Skin Deep®
<https://www.ewg.org/skindeep/>
EWG's Skin Deep® cosmetic database gives people practical solutions to protect themselves and their families from everyday exposures to potentially toxic chemicals in personal care and beauty products. Skin Deep®, launched in 2004, lists easy-to-navigate hazard ratings for nearly 70,000 products and 9,000 ingredients on the market. The U.S. government doesn't review the toxicity of products before they're sold. Companies are allowed to use almost any ingredient they wish without regard for how safe they are. The aim of Skin Deep® is to fill in where industry and government leave off.
- Shopper's Guide to Pesticides in Produce™
<https://www.ewg.org/foodnews/>
EWG analyzes data on levels of pesticides found in non-organic produce in the U.S. and uses this information to rank foods with the highest and lowest levels of pesticides. Choose foods on the [Clean Fifteen](#)™ list, and avoid foods on the [Dirty Dozen](#)™ list or eat them less often.

International Pollutants Elimination Network (IPEN)

<https://ipen.org/>

IPEN is a global network forging a healthier world where people and the environment are no longer harmed by the production, use, and disposal of toxic chemicals. Over 600 public interest, non-governmental organizations (NGOs) in more than 120 countries, largely low- and middle-income nations, comprise IPEN and work to strengthen global and national chemicals and waste policies, contribute to ground-breaking research, and build a global movement for a toxics-free future.

- Online course: *Educating Parents and Caregivers: Exposure pathways of harmful chemicals with a focus on chemical exposure on women*
<https://ipen.teachable.com/p/women-and-chemicals-03>
A new educational series will focus on the specific risks women face when exposed to toxic chemicals. The goal of the free, online course is to educate the public at large and to build a broad, woman-led leadership for addressing issues related to toxic chemical exposure. The first in the nine-part series is now available online.

Silent Spring Institute

<https://silentspring.org>

Founded in 1994, Silent Spring Institute is the leading scientific research organization dedicated to uncovering the links between chemicals in our everyday environment and women's health, with a focus on breast cancer prevention.

- *Detox Me* app
<https://web.detoxmeapp.org>

Silent Spring's Detox Me app is the most reliable clean lifestyle guide that walks you through simple, research-based tips on how to reduce exposure to toxic chemicals where you live, work and play. This free mobile app draws on more than 20 years of research by Silent Spring Institute on the health risks associated with toxic chemicals in our everyday environment, turning this vast knowledge into practical advice for healthier living.

Women's Voices for the Earth

www.womensvoices.org/

The mission of Women's Voices for the Earth (WVE) is to amplify women's voices to eliminate the toxic chemicals that harm our health and communities. WVE imagines a world where the earth is taken care of, workers are paid well and treated fairly, and there are no toxic chemicals in our homes, our communities, or our environment. In this world, every point in the cycle of production and consumption – from extraction, to processing, to use, to disposal – contributes not just to a less toxic world, but to a thriving world. In 1995, WVE founders created a new organization run by women, that recognized and uplifted the connections between gender, health, class, race, and the environment. Today, WVE leads tens of thousands of advocates across the country in campaigns to increase corporate accountability and transparency, enact health-protective laws, and take steps to reduce toxic exposure in their lives.



Photo by Samarys Sequinot-Medina

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