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# All You Ever Wanted To Know About Dioxin Or Perhaps You Really Do Not Want To Know?

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The most deadly dioxin is 2,3,7,8-tetrachloro dibenzo-p- dioxin or TCDD.

TCDD is more commonly recognized as the toxic contaminant found in **Agent Orange** and at **Love Canal**, NY and **Times Beach**, Missouri and Canadian Forces Base Gagetown.

There are 75 chlorinated dioxins, 135 chlorinated furans and 209 polychlorinated biphenyls or PCBs. Of the 419 chemicals from all three families, 30 have dioxin-like toxicity. We're usually exposed to a mixture of toxic and non-toxic members of the larger family at the same time.

When we say "dioxin" we are referring to the 30 dioxin-like chemicals of this family.

Q: Why is dioxin produced?

A: Dioxin is not manufactured intentionally. They form as an unintended contaminant or by- product during combustion or during the manufacture of certain chlorinated chemicals.

Q: How do they get into the environment?

A: Dioxins and furans can be produced when almost anything is burned under the right conditions. Two major sources are municipal waste and hospital incinerators, though emissions from these sources have been reduced in recent years because so many of these incinerators have shut down in recent years in many cases due to opposition from local grassroots community based organizations. Bleaching wood pulp with chlorine to make paper white has been another major source. Dioxin is found in the waste water released from these plants, although the amounts have declined because many plants have converted to processes that use less chlorine.

PCBs were used as insulators in electrical equipment, but their production was banned in 1977. Today, they remain in use mostly in electrical transformers and capacitors, especially in large office or apartment buildings.

PCBs are commonly found in river sediment nears plants where PCBs were generated or used.

Q: Does dioxin break down in the environment?

A: Dioxin is a highly persistent chemical that only slowly degrades in the environment. Dioxin present in surface soil may take from 9 to 15 years to degrade to half its concentration. In subsurface soil, dioxin will remain largely unchanged with time. Dioxin in water settles in sediment and can re-enter the water when the sediment are disturbed.

Q: How do dioxin emissions from incinerators reach people?

A: Dioxin goes into the air and people breathe in the particles. But a bigger problem is that the particles settle on grazing land where cows eat the grass and the dioxin gets concentrated in the fat in their meat and milk.

It also gets concentrated in cattle and hogs that are fed dioxin- tainted grain.

Dioxin particles can also fall directly into rivers, streams, and other bodies of water or reach these waterways in surface water runoff. Dioxin settles on the bottom where fish and shellfish ingest small particles of sediment. Dioxin then builds up in their fat or organs. In Maine, pregnant women are advised not to eat the green "guts" in lobsters because it's high in dioxin. People call it the "tomalley," but it's actually a combined liver and pancreas - a hepatopancreas.

Q: Do dioxins concentrate as they move up the food chain?

A: Yes. More than 90 percent of our exposure comes from food, mostly fish, meat, poultry, and non-skim dairy products. Fattier fish have more dioxin than leaner fish. Shellfish like lobsters are low in fat, but the dioxin may be in their

hepatopancreas or organs, not the meat.

Q: Does dioxin accumulate in our bodies?

A: Yes. Dioxin slowly accumulates in the body. The average levels of dioxin in the U.S. population is about 25 parts per trillion (ppt) according to the US Environmental Protection Agency (EPA). Approximately 10% of the population may have tissue levels as much as 3 times higher than this level.

Q: What does it mean to have dioxin in our bodies?

A: The USEPA has found that the body burden level of dioxin in animal studies can be related to adverse health effects observed in both animals and people.

They have also found that the average level of dioxin found in the general US population is very close to these levels. EPA interprets this to mean that there is little or no "margin of exposure" left for most people. We see this as meaning that we are nearly "full" and that any additional exposure of dioxin can result in adverse health effects. Some people already have body burden levels that are above the average and they are likely already suffering adverse health effects.

Q: Are some people more at risk from exposure to dioxin?

A: Yes. Nursing infants, some workers, people who eat fish as a main staple of their diet, such as indigenous people and fishermen, and people who live near dioxin release sources are at greater risk of developing adverse health effects from dioxin because they are exposed to higher concentrations.

Q: Can you get rid of dioxin?

A: Yes, but not easily. There's a general process within the body of accumulation and removal of toxic substances. Dioxin is accumulated in fat which is hard to get rid of. If you lose weight, you lose some dioxin with the fat. If you're breastfeeding, you get rid of it through the breast milk. Infants get their greatest dose of dioxin during breastfeeding because it's concentrated in breast milk and because the infant is so small that the dose per pound of body weight is quite high. The benefits of breastfeeding still outweigh the risks of dioxin, though we'd rather not have to make such a choice.

Q: How long does it take to get rid of dioxin?

A: Dioxin's "half-life" in the human body is about seven years. In other words, it takes about seven years for half of the dioxin in your body to be removed and then another seven years for the half of that amount and so on. This means your body will never be free of dioxin contamination.

Q: What harm does dioxin cause?

A: Exposure to dioxin can lead to a wide array of adverse health effects including cancer, birth defects, diabetes, learning and developmental delays, endometriosis, and immune system abnormalities.

Q: How can dioxin affect so many parts of the body?

A: Dioxin binds very strongly to intracellular receptors in the nuclei of animal and human cells throughout the body. So dioxin can easily get into the nucleus, where the cell's DNA is located, and wreak havoc. If it damages the DNA, that could cause cancer or birth defects. It could also alter the DNA's instructions to make normal enzymes, hormones, and other proteins, which could lead to any of a number of diseases.

Q: Can dioxin cause cancer?

A: Yes. Dioxin is a known carcinogen. TCDD is the most potent animal carcinogen ever tested. It causes tumors in both genders of every species and every strain of animal that's been tested. And the animals get different types of tumors, so it doesn't just initiate tumors, it also promotes the growth of tumors caused by other chemical initiators.

Q: Does dioxin also cause cancer in people?

A: Yes. Everyone, except perhaps some industry groups, accepts that dioxin is a human carcinogen.

IARC, the International Agency for Research on Cancer, which is part of the World Health Organization ([WHO](#)), reclassified it as a human carcinogen in 1997. In January 2001, the Department of Human Health and Services' National Toxicology Program classified dioxin as a known human carcinogen. The September 2000 draft of the USEPA's Health Assessment document on dioxin also classifies dioxin as a known human carcinogen.

Q: How powerful a carcinogen is dioxin?

A: It is the most potent substance ever tested by the USEPA or by any private or government research center. Dioxin causes cancer in multiple species in multiple organs in both sexes. Cancer in animals has resulted from exposures as low as 200 ppt.

Q: What's the chance that you will get cancer as a result of exposure to dioxin?

A: The USEPA released a draft report last fall that projected an excess cancer risk of one in 100 for the most sensitive people who consume a diet high in animal fats. In other words, the risk of getting cancer from dioxin - over and above the risk of cancer from other sources - is one in 100 for some people. This is a worst-case scenario. It's for the most sensitive people among the five percent of the population who consume the most dioxin. Scientists refer to this as the "upper bound estimate." This is a shocking estimate.

EPA's upper bound risk for the most sensitive people to average exposure is one in 1,000 which is also a serious risk level. A general "acceptable" risk level is one-in-one-million.

Some people may be exposed to little if any dioxin.

Q: Are the EPA's risk estimates reliable?

A: They're the most reliable ones we have. Several scientific peer review groups, including the agency's Scientific Advisory Board, which includes consultants outside of the agency have approved the agency's report including the methods EPA used to make their risk estimates.

Q: What kind of cancer does dioxin cause in people?

A: Most of the studies of exposed populations indicate that dioxin causes an increased risk of all cancers. Some studies suggest that it promotes lung cancer and soft-tissue sarcomas, which are cancers of the fat and muscle. Most studies don't focus on any one type of cancer because there are so few individual cancers in small studies of exposed populations.

Q: What other health problems does dioxin cause?

A: Dioxin exposure is linked to skin rashes, liver disorders, reproductive problems, birth defects, learning and developmental delays, endometriosis, immune system abnormalities, and diabetes.

Q: Do dioxins impair learning behavior?

A: PCBs appear to lower IQ or cause developmental delays in the children of women who ate large quantities of PCB-tainted fish during pregnancy. The studies that monitor these children are still on-going, so we don't know for how long the adverse effects last. Up until age seven, researchers are still finding measurable developmental delays. Over time, those delays may become imperceptible, but we don't know about IQ.

Q: How does dioxin affect reproduction?

A: Dioxins seem to impair the development of the human reproductive system. There have been case reports of hypospadias - a birth defect in which the urethra opens on the underside of the penis--in populations exposed to dioxin.

Dioxin has been shown to cause either endometriosis or a proliferation of endometrial tissue in monkeys, mice, and rats.

In humans, the evidence is less clear, but one small study found higher levels of PCBs in infertile women with endometriosis than in infertile women without the disease.

Researchers have also found a decrease in the number of male babies born in Seveso, Italy, since 1976 when there was an explosion at a chemical plant making chlorinated pesticides. The accidental explosion sent a plume of dioxin-laced smoke into the sky and the surrounding community of Seveso. Dust and particles of the dioxin-contaminated pesticide fell on people who lived downwind from the explosion. The dioxin killed pets and contaminated the soil.

A study of former Seveso residents compared the ratio of males to females born in Zone A, which was closest to the explosion, and Zone B, which was further away, to ratios elsewhere. Usually, 51 percent of newborns are male and 49 percent are female. But among children of men who lived in Seveso, only 44 percent were male in the years since 1976. And among children of men who were younger than 19 when the explosion occurred, only 38 percent were male. Zone A is still evacuated, 26 years after the explosion.

Q: Does dioxin also cause birth defects?

A: Yes. During the Vietnam War, The U.S. Military used an herbicide called Agent Orange to defoliate the jungles of Southeast Asia. The herbicide is 50 percent 2,4,5-T. Small amounts of dioxin are produced when 2,4,5-T is made, so it's an unavoidable contaminant. Studies on Vietnam veterans exposed to Agent Orange suggest that their children have an increased risk of spina bifida.

That's a birth defect that occurs when the neural tube - which develops into the spinal cord - fails to close during the first six weeks of gestation. Children born with spina bifida often lack bowel and bladder control, and many are paralyzed from the waist down or suffer from mental retardation. The evidence that dioxin causes the defect is strong enough that Vietnam veterans are compensated by the U.S. government if their children are born with spina bifida.

In animal studies, dioxin is a powerful teratogen, a substance that causes birth defects. Its teratogenic effects in animals are as dramatic as its carcinogenic effects. It causes different defects in different organs in different species and strains of animals. For example, it causes cleft palate in mice, malformed kidneys in rats, and extra ribs in rabbits.

Q: Does dioxin affect the reproductive system in men as well?

A: Yes. In animal studies, we see decreased testicular size and decreased sperm production. That's in adult rats who were exposed to dioxins before they were born. Dioxin also lowers testosterone levels in men. We don't know how dioxin damages the male reproductive system. One theory is that it's toxic to the male fetus. Another is that it damages the Y chromosome, so sperm with Y chromosomes don't fertilize eggs.

It's the Y chromosome that makes a fertilized egg develop into a male.

Q: Does dioxin impair the immune system?

A: Yes. Linda Birnbaum, EPA leading dioxin expert, calls dioxin an "immune modulator," because it makes the immune systems of animals both under-reactive and overreactive to stimuli. An over-reactive immune system may raise the risk of auto immune diseases like lupus. An under-reactive immune system is less able to respond to an antigenic challenge - that is, it makes vaccines less effective and leaves the animal less able to fight off infections and possibly diseases like cancer.

The evidence in humans is limited. But after the residents of Quail Run, Missouri, were exposed to dioxin-contaminated oil and debris from Agent Orange manufacturing plants, they had a large number of welts on a skin-prick test, which is designed to detect allergies. That meant that they were allergic to many things--it's a sign of an over-reactive immune system - though the welts diminished over time.

Q: Does dioxin cause diabetes?

A: The risk of diabetes seems to be elevated in the Ranch Hands group of Air Force troops who had the job of spraying Agent Orange in Vietnam. Researchers compared these Ranch Hand soldiers to other Ranch Hands who weren't exposed to Agent Orange who had dioxin levels that were similar to most Americans. They found that those with higher dioxin levels - within the normal range - had a higher risk of diabetes than those with lower dioxin levels.

Q: Which of dioxin's adverse effects are conclusive?

A: Most scientific groups that have evaluated the cancer evidence for dioxin agree that dioxin is a human carcinogen. The studies on veterans are strong enough that they get compensated if their children are born with diabetes or spina bifida. We have animal evidence for developmental delays and reproductive hormonal effects. The human evidence is not as strong for endometriosis and immunotoxic effects.

