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NH DIVISION OF Public Health Services
Improving health, preventing disease, reducing costs for all

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Perfluorochemicals (PFCs) Frequently Asked Questions

June 15, 2016

Please note that recent updates to the FAQs are highlighted in blue and underlined

What are PFCs?

Perfluorochemicals (PFCs), also called perfluoroalkyls, are a group of man-made chemicals that have been used for decades to manufacture household and commercial products that resist heat, oil, stains, grease, and water. Many PFCs, including perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), and perfluorohexane sulfonic acid (PFHxS) are commonly found in our environment and do not break down easily.

What are PFCs used for?

PFCs are used in a variety of industrial applications and consumer products, including manufacturing nonstick cookware and for surface protection in stain-resistant carpets, clothing, furniture, and some paper and cardboard products used for food packaging (e.g., microwave popcorn bags, fast food wrappers, and pizza boxes). PFCs are also used in products to help them flow freely; these include paints, cleaning products, and certain firefighting foams called aqueous film-forming foams (AFFFs) that are used to fight fuel-based fires. A list of commercial and industrial uses is outlined in the table below.

Certain PFCs are being phased out of use in commercial and home applications. In 2002, the company 3M, the primary manufacturer of PFOS, completed a voluntary phase-out of production of PFOS and related PFCs in the United States. In 2006, eight major manufacturers of PFCs committed to working towards the elimination of PFOA from emissions and products in the United States by 2015. The Environmental Protection Agency (EPA) estimated that these companies were on track to eliminate PFOA by the end of 2015. Other PFCs continue to be used.

Commercial Products	**Industrial Uses**
Cookware (Teflon®, Nonstick)	Photo Imaging
Fast Food Containers	Metal Plating
Candy Wrappers	Semiconductor Coatings
Microwave Popcorn Bags	Aviation Hydraulic Fluids
Personal Care Products (Shampoo, Dental Floss)	Medical Devices
Cosmetics (Nail Polish, Eye Makeup)	Firefighting Aqueous Film-Forming Foam
Paints and Varnishes	Insect Baits
Stain Resistant Carpet	Printer and Copy Machine Parts
Stain Resistant Chemicals (Scotchgard®)	Chemically Driven Oil Production
Water Resistant Apparel (Gore-Tex®)	Textiles, Upholstery, Apparel and Carpets
Cleaning Products	Paper and Packaging
Electronics	Rubber and Plastics
Ski Wax	

What do we know about PFCs in the environment?

PFCs have been found in soil, air, and water and do not break down easily in the environment. PFCs in air emissions can remain in the air for days to weeks and can travel long distances before falling to the ground where they are able to move through soil and easily enter groundwater. PFCs can also travel long distances in groundwater. Because PFCs remain in the environment for a long time, environmental exposure is still possible even after production of these chemicals has stopped.

Why are PFCs considered "contaminants of emerging concern" by the EPA?

Over the past two decades, techniques to test for PFC concentrations in water have improved. Globally, low concentrations of PFCs have been detected in many bodies of water which previously were not known to contain PFCs. The EPA generally refers to chemicals that are newly detected in the environment, or detected at higher concentrations than expected, as "contaminants of emerging concern." The label itself does not imply that PFCs necessarily cause negative health effects. Rather, it implies the need for further investigation of the health and environmental effects of PFCs.

What do we know about PFCs in the general U.S. population?

Studies show that nearly all people have PFCs in their blood, regardless of age. Some PFCs, including PFOA, PFOS, and PFHxS stay in the human body for many years. The time it takes for blood levels to go down by half is about four years for PFOA, five years for PFOS, and eight years for PFHxS, assuming there is no additional exposure to the chemical.

The Centers for Disease Control and Prevention's (CDC's) National Health and Nutrition Examination Survey (NHANES) tests for PFCs in the blood of the general U.S. population aged 12 years of age and older. As certain PFCs have been phased out of production over the last 15 years, the average level of PFOA and PFOS in people's blood has been decreasing. Based on the most recent NHANES data (2011–2012), the average blood levels in adolescents and adults are as follows:

- PFOA: 2.1 parts per billion (ppb), with 95% of the general population at or below 5.7 ppb
- PFOS: 6.3 parts per billion (ppb), with 95% of the general population at or below 21.7 ppb
- PFHxS: 1.3 parts per billion (ppb), with 95% of the general population at or below 5.4 ppb

Studies of workers at chemical plants have shown individual blood PFC levels in the hundreds or thousands of parts per billion.

[Note: 1 part per billion (ppb) = 1000 parts per trillion (ppt)]

How are people exposed to PFCs?

People are most likely to have been exposed to PFCs by ingesting them. This includes:

- Drinking contaminated water
- Eating food that may contain high levels of PFCs (e.g., fish and shellfish)
- Eating food contaminated by packaging materials containing PFCs (e.g., popcorn bags, fast food containers, pizza boxes)
- Hand-to-mouth transfer from surfaces treated with PFC-containing stain protectants, such as carpets, which is thought to be most significant for infants and toddlers

People can also be exposed by breathing air that contains dust contaminated with PFCs (from carpets, upholstery, clothing, etc.) or from fabric sprays that contain PFCs. Skin contact with the PCFs does not cause significant

absorption. Infants may be exposed to PFCs through breast milk, but PFCs do not appear to be highly concentrated in breast milk. An unborn child can be exposed to PFCs from the mother's blood because PFCs also can cross the placenta, although different PFCs cross the placenta in different amounts.

Workers in industries that manufactured or used PFCs may have been exposed to these chemicals in much greater amounts than the general public.

What are the new EPA drinking water Health Advisory levels for PFOA and PFOS?

On May 19, 2016, the U.S. Environmental Protection Agency (EPA) published drinking water Health Advisories for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS). These Health Advisories recommend a water level for PFOA and PFOS that is considered safe to drink without harming someone's health even if they were to consume water at those PFOA and/or PFOS levels over a lifetime.

These new EPA drinking water Health Advisories for PFOA and PFOS recommend that if a person's drinking water contains levels of PFOA or PFOS above 70 parts per trillion (ppt) that they should not consume the water or use it in preparing food. The Health Advisories also recommend that when both PFOA and PFOS are found in drinking water together, if the sum of the PFOA and PFOS levels is above 70 ppt the water should also not be consumed. The EPA reports that these recommended drinking water levels should be safe for all individuals including babies exposed during pregnancy, nursing infants, and children, even if these water levels are consumed over a person's lifetime.

What is a Health Advisory level?

The EPA developed the Health Advisory Program in 1978 to provide information on pollutants found to contaminate drinking water that are not regulated under the Safe Drinking Water Act (SDWA). Health Advisories identify the concentration of a contaminant in drinking water at which harmful health effects are not expected to occur if a person consumes the water over a certain timeframe. The Health Advisory level is not a federal standard that can be legally enforced and could change as new information becomes available.

How were the new EPA drinking water Health Advisory levels developed?

Because during pregnancy and breastfeeding babies are more vulnerable and potentially at risk of health effects from PFOA and PFOS exposure, the EPA created their drinking water Health Advisories by assuming a person would drink 54 milliliters of water per kilogram of body weight each day. This level of water intake was based on the estimated water consumption of a lactating mother, who would need to drink more water than a typical person to support breastfeeding. For a general 175 lb. person, this would equal more than four liters of water consumed each day. By using this high rate of water consumption to create the Health Advisories, these guideline levels are expected to be safe for pregnant mothers and their fetuses, breastfeeding mothers and their infants, and all children, adolescents, and adults.

The new Health Advisory levels are based on health effects seen in animal studies of rats and mice and not human studies. In most human studies, the amount and duration of exposure to PFOA and PFOS are unknown. The EPA also notes that most human studies have many exposures to other PFCs and/or other contaminants which create uncertainty about the cause of the health outcomes studied. The EPA used animal studies because these scientific studies were able to carefully control and vary the amount of PFOA or PFOS given to the animals, evaluate the body levels of the chemicals, and follow the animals closely to identify health effects. The EPA identified the lowest amount of PFOA and PFOS which animals were exposed to that led to harmful health effects, or the amount that was found to have no health effects on the animals. These levels were then used in a calculation to make that level of PFOA/PFOS exposure applicable to humans, taking into account water intake (discussed above), and factoring in an extra margin of safety.

What health effects are the EPAs Health Advisory levels based on?

The Health Advisory levels for PFOA and PFOS are based on developmental effects seen in rats and mice after exposure during pregnancy and nursing. Because of this, the Health Advisory levels for humans were created to be protective of developing unborn babies and infants even if water was consumed over an entire lifetime that was at or below the recommended levels. These recommended water levels are intended to protect against not only possible developmental problems, but also other potential health problems discussed below, including the possibility of cancer. The developmental effects seen in rats and mice on which the EPA based their Health Advisories include: lower birth weight, skeletal (bone formation) changes, and faster onset of puberty in male mice. These health effects, however, have not all been found or confirmed in humans.

Because of differences in how animal and human bodies process these chemicals, health effects seen in animals do not necessarily predict health effects in humans. There is some evidence to suggest that PFC exposure can contribute to lower birth weight in humans, but the identified weight difference is small and any effect on long-term health is unclear. Follow-up studies have suggested that these children with lower birth weights grow normally.

A few studies have evaluated the effect of PFCs on human sexual development and onset of puberty with inconsistent findings. Only a couple human studies have found an association between PFC exposure and delayed onset of puberty by 4–6 months, but the health implications of this finding, if true, are unclear.

There has been no evidence of bone or skeletal abnormalities in infants or children exposed to PFCs. There has also been no consistent evidence of increased miscarriages or birth defects in humans because of PFC exposure.

If a lactating mother has been exposed to PFCs, should she breastfeed her infant?

PFCs can be passed from mother to child through breast milk; however, because of the unclear long-term health consequences from PFC exposure, the many known benefits of breastfeeding are expected to far outweigh any possible health effects from PFCs that may be in breast milk. The decision about whether or not to breastfeed should not be based on PFC exposure. Concerns about PFC exposure and breastfeeding should be discussed with a child's pediatrician or other healthcare provider.

If lactating women, however, are consuming water containing PFCs at concentrations that are above the EPA's Health Advisory level, they should stop drinking the contaminated water and switch to a non-contaminated source, such as bottled water. Alternatively, they can install a home water treatment system to remove the PFCs as recommended by the New Hampshire Department of Environmental Services (NHDES): http://des.nh.gov/organization/commissioner/pfoa.htm.

Parents who prepare their infant's formula using drinking water that contains PFCs at levels above the EPA Health Advisory should switch to a non-contaminated source of water. Alternatively parents can switch to ready-to-use formula that does not require adding water.

For more information on the benefits of breastfeeding visit: www.dhhs.nh.gov/dphs/nhp/wic/breastfeeding.htm.

What health effects have been associated with exposure to PFCs?

Some animal studies have shown adverse effects in animals, but this does not necessarily predict effects in people. Human studies have evaluated whether PFCs can cause a variety of health effects, including:

- Increases in liver enzyme levels
- Increases in cholesterol levels
- Increases in blood uric acid levels

- Changes in sex hormone levels that could affect reproductive development and puberty
- Changes in thyroid hormone levels
- Lower immune function (i.e., lower antibody response to immunization)
- Effects on growth and development, including lower birth weight in infants, obesity in adolescents/adults, and effects on cognitive and behavioral development in children
- Decreased kidney function
- Incidence of insulin resistance and diabetes
- Occurrence of some types of cancers, in particular prostate, kidney, and testicular cancer

These studies have been limited in their ability to determine whether PFCs cause the studied health effects. These limitations include:

- Study designs that are not meant to determine whether an identified health concern is actually caused by PFCs
- Lack of accounting for other factors (e.g., other chemicals or behaviors) that could cause the health outcome
- Reporting only weak relationships between PFC exposure and the studied health effect, where the health effect:
  - is not medically important (too small of a health change)
  - is not statistically significant (the effect might not be related to PFCs)

While there are some studies that inconclusively suggest a relationship between PFC exposure and a health effect, there are also many studies looking at the same health outcome that do not show a relationship with PFC exposure. Given the inconsistent and sometimes contradictory findings in the medical literature, we cannot be sure about the health effects of PFCs on humans. Further study is needed to say whether PFCs cause health changes in humans.

Do PFCs cause cancer?

Animal studies have suggested an increase in certain types of glandular cancers, called adenomas, related to PFOA and PFOS exposure. These include liver, testicular, pancreatic, and thyroid adenomas. However, the way that animal bodies process these PFCs is not necessarily the same way that human bodies do. In addition, most of the animal studies looked at and evaluated significantly higher levels of exposure than those typically seen in humans. For these reasons, data on health effects in animals cannot be assumed to predict health effects in people.

The International Agency for Research on Cancer (IARC) working group classified PFOA as "possibly carcinogenic to humans," but has not classified PFOS. The EPA in their PFOA and PFOS Health Advisories notes that there is "suggestive evidence for carcinogenic potential" in humans.

So far, however, studies of PFCs in humans have not shown conclusive evidence that PFC exposure leads to various cancers. Some studies have suggested a possible connection between PFC exposure and cancers of the prostate, kidney, and testicles. These include studies of workers exposed to high levels of PFCs and studies of people exposed to lower levels through environmental contamination. These studies have the same limitations mentioned above, which limit their ability to determine whether PFCs cause cancer.

The Centers for Disease Control and Prevention's Agency for Toxic Substances Disease Registry (CDC/ATSDR), in their review of the science, reports that "there is no conclusive evidence that perfluoroalkyls cause cancer in humans. Some increases in prostate, kidney, and testicular cancers have been seen in individuals exposed to high levels. These results should be interpreted cautiously because the effects were not consistently found and most studies did not control for other potential factors such as smoking." (http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=1116&tid=237)

Are PFCs a health risk to infants and children?

Hand-to-mouth behavior is a significant source of PFC exposure for infants and toddlers who crawl on the floor and often put their hands or objects into their mouths, causing PFCs from environmental sources (carpets, dust, etc.) to be ingested. Because they are smaller, children also can be exposed to higher doses of PFCs for their body weight than an adult. Infants may be exposed to PFCs through breast milk, and an unborn child can be exposed to PFCs from the mother's blood because PFCs can cross the placenta, although different PFCs cross the placenta in different amounts.

There has not been any convincing evidence that PFC exposure has an effect on miscarriage or birth defect rates. One of the most studied health outcomes has been the effect of PFOA and PFOS exposure on birth weight and size of fetuses (unborn babies). Some studies have found that PFOA and PFOS exposure may lead to decreased fetal weight and size. Follow-up studies, however, have suggested that these children with lower birth weights grow at normal rates.

A variety of health outcomes in children have been studied related to PFOA and PFOS exposure, including fetal growth and development, cognitive and behavioral development, immune function, thyroid function, and reproductive development and function. While some studies have suggested a relationship between PFC exposure and these health outcomes, there are also many studies that do not show a relationship with PFC exposure. Given the inconsistent findings, further study is needed to determine if there is a true association.

What should I do if I think a personal health problem is connected to PFC exposure?

You should discuss your concerns with your healthcare provider. Unfortunately, it is not possible to connect any current health problem to past/current PFC exposure. While some health studies have found health connections with PFC exposure, the studies are inconsistent and it remains unclear if PFCs cause any of the health problems mentioned above. Your healthcare provider, however, can help assess your current health or medical issue and make a determination about what next steps might be important.

What should I do if I'm concerned that PFC exposure may cause future health problems?

You should discuss your concerns with your healthcare provider. Unfortunately, it is not possible to connect past/current PFC exposure to any future health problem that might develop. While some health studies have found associations with PFC exposure, the studies are inconsistent and it remains unclear if PFCs cause any of the health problems mentioned above. Your healthcare provider can help address your concerns and follow your health over time.

Are there any medical tests I need to have performed by my healthcare provider since I may have been exposed to PFCs?

There are no specific tests that are medically necessary or recommended. Any decisions on further testing or follow-up evaluation should be made in consultation with your healthcare provider. The New Hampshire Department of Health and Human Services (DHHS) has provided information and recommendations to healthcare providers in New Hampshire so they can have an informed discussion with patients about the health significance of PFC exposure.

DHHS is recommending that all healthcare providers follow their patients and perform any routine diagnostic or screening tests as medically indicated, based on a history, physical examination, and assessment, and not based solely on PFC exposure.

Should I have my blood tested for PFCs?

Blood testing for PFCs is not currently recommended because it is unclear how a specific blood PFC level relates to an individual's health, and test results can be difficult to interpret with limited medical use. We do not know how to interpret a PFC blood level as it relates to a person's health**.** There is not currently an established blood PFC level at which a health concern exists, and a blood level is unable to predict past or future health problems. A blood PFC level is only able to tell a person how much of certain PFCs a person has in his/her body at the time of the blood test from all sources of exposure. A person can compare their PFC blood levels to those of other study populations, such as testing performed through the CDC's National Health and Nutrition Examination Survey (NHANES), but this only offers a comparison to levels typically found in the general U.S. adolescent and adult population and does not specify a level at which a health problem might occur.

How can I get my blood tested for PFCs?

PFC blood testing is not medically necessary or recommended. We understand that some people will want more information about their level of PFC exposure, so DHHS will make PFC blood testing available to individuals beginning in July 2016. DHHS will be sending information to individuals who reside on streets that are served by private water drinking wells that have registered PFOA and/or PFOS levels above 70 ppt. DHHS will also be communicating with healthcare providers to help inform them about PFCs and to understand the NH DHHS recommendations and how to interpret PFC blood test results.

Individuals whose drinking water did not test above the EPA health advisory levels but who want to have PFC blood testing performed can contact one of the laboratories listed below that NH DHHS has identified that are able to accept clinical specimens directly from healthcare providers:

- Vista Analytical Laboratory (phone: 916-673-1520, website: www.vista-analytical.com)
- NMS Laboratory (phone: 866-522-2206, website: http://www.nmslabs.com)

Patients or healthcare providers should call the laboratory to discuss the cost of testing, how to submit a specimen, and the panel of PFCs tested. Healthcare providers should also talk with their normal hospital or reference laboratory as their clinical laboratory may have a way to send a patient's blood for PFC testing.

Why are there different recommendations among states about how to manage patients exposed to PFCs?

There are currently no national guidelines for how healthcare providers should respond to patients exposed to PFCs. These chemicals are found widely in our environments, and further research is needed to determine health risks after exposure. In the absence of clear national guidance, each state is responding in their own manner as PFC exposure situations arise. The CDC/ATSDR is currently in the process of developing national guidance for healthcare providers, so recommendations may change.

Is there any medical "treatment" for PFCs in the body?

There is no medically approved treatment for finding PFCs in a person's body and no proven way to remove them more quickly. Levels in the body should decrease slowly over time once the exposure ends.

How do I reduce my family's exposure to PFCs in the future?

Families can reduce their exposure to PFCs by limiting their use of consumer products that may contain PFCs. This includes:

- Greasy or oily food that comes packaged in material that may use PFC-containing grease repellent linings, such as microwave popcorn bags, fast food containers, and pizza boxes.

- Use of stain-resistant sprays that may contain PFCs on furniture, carpets, and clothing.
- Use of other products with the words “fluoro” or “perfluoro” in their ingredients list.

Additionally, because PFCs can easily contaminate ground water, residents with drinking water supplied by private wells can have their water tested for PFCs if there is suspicion for PFC contamination. Residents with private wells contaminated by PFOS and PFOA above the EPA’s Health Advisory levels should find an alternate source of drinking water or install point-of-use treatment devices to filter their tap water.

To reduce PFC exposure through drinking water, we recommend reviewing the information found on the New Hampshire Department of Environmental Services (NHDES) website about water testing and treatment for PFCs: http://des.nh.gov/organization/commissioner/pfoa.htm.