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

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Healthcare Provider Frequently Asked Questions (FAQs)

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What are PFCs and where are they found?

Perfluorochemicals (PFCs), also called perfluoroalkyl and polyfluoroalkyl substances (PFAS), are a group of synthetic chemicals that have been used for decades to manufacture household and commercial products that resist heat, oil, stains, grease, and water. PFCs have been used in many consumer products including non-stick cookware, stain resistant furniture and carpets, waterproof clothing, microwave popcorn bags, fast food wrappers, pizza boxes, shampoo and dental floss. They have also been used in certain firefighting foams and various industrial processes because they have surfactant properties that help products flow freely. Many PFCs, including perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), and perfluorohexane sulfonic acid (PFHxS) are commonly found in our environment because they do not break down easily. The Environmental Protection Agency (EPA) has classified PFCs as contaminants of emerging concern because of their widespread use and potential to affect human health.

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 in areas of water contamination)
- 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

Certain PFCs have been phased out of industrial and commercial use in the United States, including PFOA and PFOS. PFOA, for example, should no longer be found in food packaging; however, these PFCs can still be found in home products and as contaminants in the environment. Also, the products that PFOA and PFOS have been removed from may contain other types of PFCs.

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 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. Occupational workers at facilities that manufacture or use products with PFCs can be exposed to high levels of certain PFCs, mainly by inhalation.

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

What is a Health Advisory level?

The U.S. Environmental Protection Agency (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 adverse health effects are not anticipated to occur over a defined exposure timeframe. The Health Advisory value is not a legally enforceable federal standard and is subject to change as new information becomes available.

What are the Environmental Protection Agency (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 present guideline concentrations for PFOA and PFOS in drinking water to provide a conservative margin of protection from possible adverse health effects over a lifetime of exposure; the Health Advisories do not represent definitive cutoffs between safe or unsafe levels. PFOA and PFOS are the only two PFCs for which the U.S. Environmental Protection Agency (EPA) has developed health advisory levels in drinking water.

The EPA drinking water Health Advisories for PFOA and PFOS advise that if a person's drinking water contains levels of PFOA and PFOS, either individually or combined, above 70 parts per trillion (ppt) that they do not consume the water or use it for food preparation, brushing teeth, or any activity that might result in ingestion of water. Due to how these guideline levels were developed, the EPA expects them to be protective for all individuals including babies exposed in-utero, nursing infants, and children, over a lifetime of exposure.

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

Because babies during the period of pregnancy and breastfeeding are potentially more susceptible to health effects from PFOA and PFOS exposure, the EPA calculated their drinking water Health Advisories based on the water consumption of a lactating mother by estimating that a lactating woman would drink 54 mL/kg/day of water. For a general 175 lb. person, this would equal about 4.3 liters of water consumed each day. By using this rate of water intake to calculate the Health Advisories, the guideline levels are expected to be safe for pregnant mothers and their fetuses, lactating mothers and their infants, and all children, adolescents, and adults.

The Health Advisory levels are based on health effects seen in animal studies of rats and mice. In most human studies, the amount and duration of exposure to PFOA and PFOS are unknown, and the EPA also notes that most human epidemiologic studies have many PFCs and/or other contaminants in their blood or exposures that create uncertainty about the cause of health outcomes. The EPA used animal studies because these scientific studies were able to control the amounts 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 looked at health outcomes in animals to identify the lowest levels of exposure that led to observed health effects and then a calculation was performed to make that number applicable to humans, taking into account water intake (discussed above), and factoring in an extra margin of safety.

Further information about the EPA's health advisory levels can be found at:
https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos

What health effects are the EPA's Health Advisory levels based on?

Calculations for the Health Advisory levels for PFOA and PFOS are based on developmental effects seen in rats and mice after exposure during pregnancy and lactation (nursing). The drinking water Health Advisory levels for humans are expected to be protective of developing fetuses and infants over a lifetime of exposure, including not only possible developmental effects, but other potential cancerous and non-cancerous health effects which are currently undergoing further study. 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 accelerated puberty in male mice.

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. Published systematic reviews of the literature with meta-analyses have estimated that for every 1 µg/L increase in a mother's PFOA blood level, birth weight is reduced by 0.03-0.04 pounds; estimated reductions in weight due to PFOS are even less. The long-term health implications of these findings are unclear and follow-up studies have suggested that these children with lower birth weights grow at normal rates.

Very few studies have evaluated the effect of PFCs on human sexual development and onset of puberty with inconsistent findings. 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 accurate, are unclear.

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

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

PFCs are passed from mother to baby through breast milk; however, breastfeeding is recommended even if a mother has been exposed to PFCs because the benefits from breastfeeding for mother and child outweigh potential health risks given our current scientific understanding of PFCs. Breastfeeding decreases obesity, helps the immune system and enhances brain development.

Lactating women consuming water containing PFCs above the EPA's Health Advisory level of 70 ppt, however, should stop drinking the contaminated water and switch to a non-contaminated source, such as bottled water. They can also 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**.

Similarly, 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.

What health effects have been associated with exposure to PFCs?

While studies in humans do not consistently or conclusively show that PFCs cause any specific health effects, they suggest that PFCs could affect a variety of possible health endpoints, including:

- Increases in liver enzyme levels
- Increases in cholesterol levels
- Increases in 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
- Occurrence of some types of cancers, in particular prostate, kidney, and testicular cancer

It is difficult to interpret these studies, however, because they are limited in their ability to determine whether PFCs cause the studied health effects. Findings between studies are inconsistent, there is usually a lack of accounting for other confounding factors that could be contributing to the studied health outcome, and many of the reported health associations with PFC exposure are either weak or not medically significant (i.e. small thyroid hormone changes within the normal reference range). More studies are needed to be sure which health effects, if any, are caused by exposure to PFCs and whether these effects are significant.

The Centers for Disease Control and Prevention's Agency for Toxic Substances Disease Registry (CDC/ATSDR) published a draft *Toxicological Profile* in August 2015 (**http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=237**) which reviews and summarizes the studies on health effects of PFCs. ATSDR highlights that several health effects have been more consistently identified, including:

- Increases in total blood cholesterol
- Increases in some liver function tests (LFTs)
- Increases in blood uric acid levels
- Lower birth weights for infants born to mothers with PFC exposure

What these identified associations ultimately mean for a person's health is unclear because they are biomarkers and not concrete health endpoints. There have not been clear associations between PFC exposure and cardiovascular disease or liver disease (i.e., hepatitis, cirrhosis, etc), for example, and it is unclear how a higher uric acid level related to PFC exposure might affect a person's health. It is also unknown what the long-term impact of lower infant birth weights is since the identified weight difference is small and follow-up studies have suggested that these children grow at normal rates.

Do PFCs cause cancer?

The International Agency for Research on Cancer (IARC) working group classified PFOA as "possibly carcinogenic to humans" (group 2B), 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. The CDC/ATSDR 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 there any specific health effects I should be concerned about in exposed infants or children?

There has not been any convincing evidence that PFC exposure has an effect on miscarriage or birth defect rates. Studies suggest that maternal PFOA and PFOS exposure may lead to small decreases in the birth weight and size of infants. A variety of other health outcomes in developing 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; however, these studies on infant/child health outcomes have not shown consistent findings nor been clear about whether an infant's/child's health is adversely impacted by exposure to PFCs. Therefore, while babies exposed to chemicals during the period of pregnancy and breastfeeding are potentially more susceptible to health effects, more research is needed to better understand long term health effects in infants and children exposed to PFCs.

What is the C8 Health Study?

C8 refers to PFOA because PFOA has an 8-carbon chain. The C8 Health Study is one of the largest and most important studies of health effects in a community exposed to PFOA from a DuPont chemical plant, primarily through oral ingestion of contaminated water. As part of a class action lawsuit settlement, a health study of more than 69,000 individuals affected by the contamination was performed, and a panel of three independent epidemiologists reviewed the science of PFOA exposure and health effects to make determinations about whether there was a "probable link" between PFOA exposure and various health outcomes.

The term "probable link" is a legal term and was defined as "more likely than not among class members a connection exists between PFOA exposure and a particular human disease" (**http://www.c8sciencepanel.org/prob_link.html**). The determination of a "probable link" was defined by the class action lawsuit settlement and made by the three epidemiologists. The following table shows the health outcomes for which a "probable link" was not found, and six health outcomes for which a "probable link" was determined based on evaluation of the science by the epidemiologists:

C8 Science Panel Link Reports	
Not a "Probable Link"	**"Probable Link"**
Hypertension	High cholesterol
Coronary heart disease	Thyroid disease
Stroke	Ulcerative colitis
Chronic kidney disease	Pregnancy-induced hypertension
Liver disease	Testicular cancer
Osteoarthritis	Kidney cancer
Parkinson's disease	
Autoimmune diseases other than ulcerative colitis	

Common infections (i.e., colds, influenza, etc.)	
Neurodevelopmental disorders, including ADHD and learning disabilities	
Asthma or COPD	
Diabetes mellitus type 2	
Birth defects	
Miscarriage or stillbirths	
Preterm birth or low birth weight	

As part of the class action lawsuit settlement against DuPont, an independent Medical Panel was established to develop medical guidelines for screening C8 Class Members to identify whether members had any of the six "probable link" conditions. As part of the settlement, the Medical Panel released a Medical Monitoring Protocol: **http://www.c-8medicalmonitoringprogram.com/docs/med_panel_education_doc.pdf**.

Nationally, there are no official medical guidelines recommending additional clinical testing due to PFC exposure, but some patients may ask for medical screening/testing similar to that which was conducted in the C8 Health Study, and healthcare providers should be prepared to have discussions with patients about the risks and benefits of any further testing.

What do I tell my patient who thinks his/her health problem(s) are related to PFC exposure?

The current evidence is not conclusive regarding whether PFCs cause certain health outcomes. Some health problems that patients present with could potentially be associated with PFC exposure, especially if mentioned in the health effects section above. Health problems, however, can be caused by multiple different factors, and given the limitations in the science, it is not possible to know if past/current PFC exposure has caused any problems or made them worse. If your patient presents with health concerns that might be associated with PFC exposure, you should discuss the concern and perform a thorough health and exposure history and also a physical exam.

What do I tell my patient who is worried future health problems might occur because of PFC exposure?

It is not possible to predict future health effects after exposure to PFCs, and although human and animal studies suggest that certain PFCs could affect human health, these studies are inconsistent and not conclusive about whether PFCs cause adverse health outcomes. The list of possible health effects that might be caused by PFCs include: increases in cholesterol levels, changes in liver function and thyroid function tests, effects on children's growth and development, effects on the immune system, and increases in specific types of cancer. More research is needed to better understand future health risks from PFC exposure. Healthcare providers should discuss patients' concerns and engage patients to determine what medically acceptable steps could help address health concerns.

Should I have my patient's blood tested for PFCs?

The PFC blood test is not a medical test that will help determine the cause of a health problem or provide information for treatment. The blood test will tell you how much of each PFC is in a person's blood at the time of the test. Because there are no currently established PFC blood levels at which a health problem is known or expected to occur, the blood test cannot predict or rule-out the development of future health problems that might be related to PFC exposure.

Blood testing provides individuals with information about their individual levels of PFC exposure, and some have expressed interest in knowing their blood levels because it may provide information in the future as research continues and more science emerges. For this reason, and to better understand exposure patterns within

communities, NH DHHS has made PFC blood testing available to exposed communities. For more information about the DHHS PFC Blood Testing Program, please call 603-271-9461.

How can I get my patient's blood tested for PFCs?

If your patient may have been exposed to PFCs through contaminated drinking water, NH DHHS is offering blood testing to eligible individuals in communities where PFOA and/or PFOS levels above 70 ppt have been identified based on testing of drinking water by the New Hampshire Department of Environmental Services (NHDES). Individuals interested in having their blood tested for PFCs should understand the uses and limitations of a PFC blood test before deciding on testing. More information on PFC blood testing is available at **http://www.dhhs.nh.gov/dphs/pfcs/blood-testing.htm**.

My patient got his/her blood tested for PFCs, what do the results mean?

Based on the current science, we do not know how to interpret a PFC blood level as it relates to a person's health**.** There currently are no established PFC blood levels at which a health problem is known to occur nor is there a level that predicts 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 levels with 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. An individual's PFC levels can also be compared with the levels found in the NH Pease Tradeport community, and other tested communities in NH, which have been exposed to PFCs through contaminated drinking water:

- CDC NHANES: **http://www.cdc.gov/biomonitoring/pdf/FourthReport_UpdatedTables_Feb2015.pdf**
- NH DHHS Website: **http://www.dhhs.nh.gov/dphs/pfcs/index.htm**

Because of the uncertainty around what a PFC blood level means for an individual's health, healthcare providers should discuss and engage with patients about their health concerns.

Should I retest my patient's blood for PFCs in the future?

Because there is no medically approved way to remove PFCs from the body faster, and because PFC levels in the blood decrease slowly over time after removal of exposure(s), repeat PFC blood testing is not necessary.

Should I check my patient's blood for effects from PFC exposure (e.g., liver, thyroid, etc.)?

There are no national medical recommendations for how to monitor health after PFC exposure. We recommend maintaining regular healthcare visits, conducting routine health screenings, monitoring for symptoms of illness, and basing further testing on your history, physical exam, and assessment of a patient's presenting issue or concern. Abnormal laboratory tests, however, can be caused by multiple different factors or health conditions, so you will not be able to know that an abnormal test is because of PFC exposure. Given the uncertainty around what PFC exposure means for a person's health, some patients may request certain blood testing, and healthcare providers should discuss with their patients, on an individual level, the benefits as well as the risks of further testing. Healthcare providers are in the best position to determine how best to monitor their patients' health given the limitations of the science.

Is there any medical "treatment" for finding PFCs in my patient's blood?

There is no medically approved treatment for finding PFCs in a person's body. There have been very few studies that have evaluated human PFC levels after treatment with investigational therapies such as routine phlebotomy and bile acid sequestrates (e.g., cholestyramine), but the evidence is very limited, and these treatments can have adverse consequences.

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

There have been 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 the risk of health effects after exposure. In the absence of clear national guidance, each state has been responding in its own manner as PFC exposure situations arise. The CDC's Agency for Toxic Substances Disease Registry (ATSDR), however, recently released some provisional guidance for healthcare providers, which can be found at: **http://www.atsdr.cdc.gov/pfc/docs/pfas_clinician_fact_sheet_508.pdf**.

Where can I refer my patient to see a specialist who knows more about PFCs?

NH DHHS is working with environmental health physicians at the Region 1 Pediatric Environmental Health Specialty Unit (PEHSU) in Boston, and Dartmouth-Hitchcock Medical Center in Lebanon and Dartmouth-Hitchcock Clinic in Nashua or Keene, to support healthcare providers by offering clinic visit referrals for health concerns related to PFC exposure. NH DHHS is also working with the Northern New England Poison Center (NNEPC) to provide phone consultation services to answer more immediate questions. These services can be accessed through the contact information below:

Immediate questions or assistance through the NNEPC:

- 1-800-562-8236

Region 1 Pediatric Environmental Health Specialty Unit (PEHSU) referral:

- Adult referrals: 617-665-1580
- Child referrals: 617-355-8177

Dartmouth-Hitchcock Medical Center environmental health referral:

- **http://med.dartmouth-hitchcock.org/referrals/lebanon_referrals.html**
- Telephone: 866-346-2362

Questions about the DHHS PFC Blood Testing Program can be directed to the State Public Inquiry Line: 603-271-9461