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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 perfluoroalkyls, 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. They are also used in products as surfactants to help them flow freely. 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. A list of commercial and industrial uses is outlined in the table below.

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	

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 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.

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 Center for Disease Control and Prevention'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, with 95% of the general population at or below 5.7 parts per billion
- PFOS: 6.3 parts per billion, with 95% of the general population at or below 21.7 parts per billion
- PFHxS: 1.3 parts per billion, with 95% of the general population at or below 5.4 parts per billion

What health effects have been associated with exposure to PFCs?

Various health effects are currently being studied in humans for association with PFC exposure; these studies include evaluation of whether PFCs may cause:

- Increases in liver enzymes 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
- Decreased kidney function
- Incidence of insulin resistance and diabetes
- Occurrence of some types of cancers, in particular prostate, kidney, and testicular cancer

It is difficult to interpret these studies because they are limited in their ability to determine whether PFCs cause the studied health effects. These limitations include:

- Inconsistent findings between studies with some finding associations, and others looking at the same health outcome not identifying an association
- Study designs that are not meant to determine whether an identified health concern is actually caused by PFCs
- Lack of accounting for other confounding factors (e.g., other chemical exposures or behaviors) that could cause the health outcome studied
- Reporting only weak relationships between PFC exposure and the studied health effect, where the health effect:
 - is not medically important and too small of a change to matter clinically (i.e. thyroid hormone levels associated with PFC exposure)
 - is not statistically significant (the effect might not be related to PFCs)

The Center for Disease Control and Prevention's Agency for Toxic Substances Disease Registry (CDC/ATSDR) recently 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 blood total cholesterol
- Increases in some liver function tests (LFTs)
- Increases in blood uric acid levels
- Lower infant birth weights born to mothers with PFC exposure

What these identified associations ultimately mean for a person's health is unclear; 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?

Studies of PFCs in humans have not shown conclusive evidence that PFC exposure leads to various cancers. These studies have the same limitations mentioned above, which limit their ability to determine whether PFCs cause cancer. 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. One of the most studied health outcomes has been the effect of maternal PFOA and PFOS exposure on birth weight and size of fetuses. 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 low birth weight grow at normal rates.

A variety of 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. While some studies have suggested a relationship between PFC exposure and these health outcomes, there are also many studies that do not show a connection with PFC exposure. Given the inconsistent findings further study is needed to determine if there is a true association.

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 an environmentally exposed 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 on 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 is 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 does not represent the consensus of the medical or scientific communities about the health effects from PFOA or other PFCs. The following table shows the health outcomes for which no link was 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	

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

It is not possible to connect any current health problem to past/current PFC exposure. While some health studies have found health associations with PFC exposure, the studies are inconsistent and it remains unclear if PFCs cause any of the health problems outlined above. If a patient presents with concerns that a health issue is connected to PFC exposure, the healthcare provider should take the concern seriously and perform a thorough history and physical exam relative to the issue in question.

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

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 outlined above. Healthcare providers should take patients’ concerns seriously and discuss what steps could help address concerns the patient has for his/her health. Healthcare providers should follow their patients over time and perform thorough interviews and physical exams as medically indicated.

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

There is no medical recommendation from the New Hampshire Department of Health and Human Services (NH DHHS), or from federal public health partners (i.e., CDC/ATSDR), that healthcare providers perform baseline or screening blood tests, such as liver function tests, thyroid function tests, cholesterol levels, or uric acid levels, to look for health effects possibly associated with PFC exposure. It is unclear how such testing would be clinically useful since PFC exposure would not be able to be linked to any abnormalities found on testing.

Any diagnostic or screening tests should be performed as medically indicated, based on a healthcare provider's history, physical examination, and assessment, and not specifically 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 it is up to the discretion of the healthcare provider in discussion with the patient on whether further testing may be warranted on a case-by-case basis.

Should I have my patient's 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 utility to guide further medical decision making.

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

PFC blood testing is not commonly available, and is not medically recommended. If a patient and provider decide to test a patient's blood for PFCs, NH DHHS has identified two different laboratories 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>)

Providers should call the laboratory to discuss cost of testing, how to submit a specimen, and 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.

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

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 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.

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

There is currently no medical reason to retest. Because there is no medically approved way to remove PFCs from the body faster, and because we expect PFC levels in the blood would decrease slowly over time after removal of exposure(s), we do not recommend repeat PFC blood testing. If a healthcare provider decided to perform repeat testing, it would need to be several years after the initial test because of the long time that PFCs like PFOA, PFOS, and PFHxS remain in the body.

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 and no proven way to remove them more quickly. 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 are not without potential adverse consequences. Therefore, none of these therapies are recommended after finding PFCs in a person's body.

Why are there different recommendations between 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 risk of health effects after exposure. In the absence of clear national guidance, each state is responding in their own manner as PFC exposure situations arise. Some states have decided to test people's blood for PFCs to determine the level of exposure, and some states have suggested that healthcare providers consider blood testing looking for end-organ effects, such as checking liver function tests (LFTs), thyroid function tests (TFTs), and lipid panels.

Given the unclear utility of such testing, and in the absence of national medical guidelines, NH DHHS is not recommending that further blood testing be performed, but healthcare providers can make individualized decisions for blood testing, as discussed above, based on discussions with their patients. NH DHHS is continuing to work with CDC/ATSDR to try and develop more consistent national guidance for healthcare providers, so recommendations may change.

Are there any standards for PFCs in drinking water?

There are currently no state or federal enforceable standards for PFCs in drinking water. The U.S. Environmental Protection Agency (EPA) has developed a provisional drinking water Health Advisory for PFOS and PFOA for short-term exposure. The Provisional Health Advisory (PHA) reflects drinking water levels that are currently considered safe for both adults and children over the short term. The current EPA short-term PHA levels are 400 parts per trillion (or 0.4 parts per billion) for PFOA and 200 parts per trillion (or 0.2 parts per billion) for PFOS. These PHA levels were established back in 2009 based on data from animal studies, but the EPA is currently in the process of developing a lifetime Health Advisory for water for PFOS and PFOA, which should be protective for adults and children over the lifetime. We are expecting the updated Health Advisory levels in the next couple of months; however, in the interim, some states have developed their own. New Hampshire has not developed its own health advisory level and until the updated EPA advisory is published, as part of the Saint-Gobain response, the New Hampshire Department of Environmental Services (NHDES) has decided to provide bottled water to individuals in Merrimack and Litchfield, NH whose drinking water has been found to contain over 100 parts per trillion of PFOA.

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

Any environmental health physician or specialist would likely have the ability to discuss PFC exposure and health implications further with your patient. NH DHHS has been working with a group of environmental health physicians in Boston (associated with Boston Children's Hospital and Cambridge Health Alliance) to be able to provide consultation services through a primary care referral pathway. Healthcare providers who want to refer their patient can call the numbers below:

- Adult healthcare providers: 617-665-1580
- Child healthcare providers: 617-355-8177