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In reply, please refer to:
File:

March 11, 2022

MEDICAL ADVISORY:

CHEMICAL SCREENING (AKA BIOLOGICAL MONITORING) FOR EXPOSURES TO PETROLEUM HYDROCARBONS IN DRINKING WATER

- CHEMICAL SCREENING FOR EXPOSURES TO PETROLEUM HYDROCARBONS IN DRINKING WATER IS NOT RECOMMENDED
- PATIENTS PRESENTING WITH SYMPTOMS POSSIBLY RELATED TO EXPOSURE TO CONTAMINATED WATER SHOULD BE EVALUATED WITH A THOROUGH HISTORY AND PHYSICAL
- DIAGNOSTIC TESTING SHOULD BE DRIVEN BY THE CLINICAL EVALUATION

Dear Healthcare Provider:

Background: Since November 2021, thousands of people on Oahu have sought medical care related to possible exposure to petroleum hydrocarbons in the drinking water. Patients and families are interested in chemical screening of body tissues and fluids, or "biological monitoring," to help document exposure and predict current and future health effects. This type of assessment, while a useful tool in a variety of situations, has limited application in evaluating patient complaints specific to petroleum contamination in drinking water.

Summary: Available blood and urine testing **cannot:**

- Reliably indicate exposure to JP-5 jet fuel in drinking water
- Determine if presenting symptoms are from exposure to petroleum hydrocarbons in drinking water
- Predict potential future health effects
- Help direct management of patient's symptoms or clinical condition

Because of these limitations, biological testing related to exposure to petroleum hydrocarbons in drinking water is not recommended. Patients presenting with symptoms possibly related to exposure to the water should be evaluated with a thorough history and physical.

- History should include all pertinent details of symptom onset and evolution, potential exposures (including occupational), and additional symptoms
- Diagnostic testing should be driven by the clinical evaluation

Explanation: The utility of blood or urine screening for a specific chemical or metabolite should include consideration of:

- The chemicals of interest
- What happens to the chemicals once inside the body (metabolism)
- How the chemicals will leave the body and how quickly that will happen (elimination)
- How specific the results are with regard to a given exposure
- Whether the result will reliably indicate exposure, health effects from an exposure or direct treatment

Petroleum products such as JP-5 jet fuel are comprised of hundreds of different hydrocarbon compounds, each present at a relatively low concentration within the overall mixture. Once absorbed into the bloodstream, certain compounds can be detected in the blood for a very brief period of time. However, these compounds require very specific laboratory methods and can only be detected if found at high enough concentrations. In many cases, the majority of hydrocarbon compounds that enter the body will disappear from the blood within a matter of hours (<1 day), further decreasing the likelihood that they will be detected in the blood.

For each type of compound, there is a "window" in which the compound or a metabolite may be detected in blood or urine. In most cases, the half-life (i.e., the time it takes to reduce the concentration in the body by 50%) for many of the hydrocarbons found in petroleum products is on the order of a few to 15 hours. This means that >50% of the amount of the compound/metabolite will have left the body within the first 24 hours after an exposure, and >75% will have left within 48 hours. Therefore, for biological testing to detect the presence of these compounds or their metabolites, specimens must be collected within hours of the exposure.

It should also be considered if the compound(s)/metabolite(s) tested for would indicate exposure to a chemical or be specific to a particular exposure or event. In this particular case of petroleum hydrocarbons in the drinking water, there are no identifying compounds that may be detected during biological monitoring which are specific to JP-5 fuel exposure. Many of the compounds that can be identified in blood or urine testing are also commonly found in the environment such as in standard gasoline, cigarette smoke and air pollution. Detection of these chemicals in blood or urine does not clearly indicate the source of the exposure and may instead represent exposure from regular daily activities.

Uncertified laboratories are offering urine testing for many compounds or metabolites that may be misinterpreted to be an accurate marker of exposure to petroleum hydrocarbons.

- Laboratory methods and comparison controls are often not validated or clearly reported
- Results from these uncertified laboratories do not have evidence-based values for intervention, nor do they accurately indicate exposure
- Care should be taken to fully understand the utility and limitations of these laboratory tests prior to ordering them, particularly when the analysis requires payment out of pocket

Some examples of chemicals reviewed as possible candidates for biomonitoring and determined to not be useful related to exposure to petroleum hydrocarbons in drinking water include:

- **Total Petroleum Hydrocarbons (TPH):** Requires specialized collection and laboratory instrumentation and samples must be collected within hours of exposure.
- **Benzene** (metabolite: N-Acetyl Phenyl Cysteine (NAP))**:** Benzene is a confirmed component of JP-5 jet fuel; however, the amount of benzene in JP-5 is <0.2% of the overall mixture. The

very low level likely contributes to why the drinking water samples taken throughout the Navy Water System and at the Red Hill well did not have detectable levels of benzene. Given the very small amount of benzene in JP-5 jet fuel, there would not likely be high enough levels to be detected in blood or urine of people drinking the contaminated water. The half-life for benzene is very short (6-15 hours) so if benzene were present, samples would need to be collected within hours to a day of exposure. Further, any detection of benzene or NAP does not necessarily imply that JP-5 was the source, since cigarette smoke, gases, exhausts, glues, paints, and many other common exposures can also introduce benzene into the body through inhalation.

- **Xylenes** (metabolite: methylhippuric acids): Xylenes are present at very low concentrations in JP-5 and are also constituents of standard gasoline used in automobiles, paints, varnishes, inks, adhesives and various cleaning agents. Detection of methylhippuric acids in the urine may indicate that xylenes were present in the body but does not identify the source of xylene exposure. Sampling of the jet fuel spilled into the Red Hill Aquifer does not indicate a significant presence of xylenes and drinking water samples have confirmed that xylenes are not present in a significant amount in this contamination incident.
- **Methyl Tert-Butyl Ether (MTBE)/ Ethyl Tert-Butyl Ether (ETBE)** (metabolite 2-Hydroxyisobutyric Acid (2HIB))**:** MTBE and ETBE are not components of jet fuel. They are additives to gasoline that improve octane ratings. Findings of, or increases in, MTBE/ETBE in biological samples are not due to jet fuel exposure. In addition, urine testing for MTBE/ETBE is usually through the detection of the metabolite 2-Hydroxyisobutyric Acid (2HIB). 2HIB is also formed normally within the body from degradation of branched-chain amino acid degradation and ketogenesis.
- **Perchlorate:** Perchlorate is commonly found in the environment. It is a component of fireworks, and rocket and missile fuels, but is not a component of jet fuel. It is used industrially in the production of many items including fertilizers, and frequently ends up in food due to its use in food packaging.

If you have questions about a possible laboratory test option and its utility in aiding your care of a patient exposed to petroleum hydrocarbons in drinking water, please contact the Hawaii Department of Health State Toxicologist Dr. Diana Felton (808-586-0963 diana.felton@doh.hawaii.gov) or Navy Region Hawaii Public Health Emergency Officer, Commander/Dr. Patrick Hennessey (808-465-9030 patrick.j.hennessey2.mil@mail.mil).

Sincerely,

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