EPA characterization of studies identified after public release of the draft IRIS Toxicological Review of Perfluorohexanesulfonic Acid (PFHxS, CASRN 335-46-4) and Related Salts

Tables 1 and 2 below describe literature identified during the 2023 literature search update performed after release of the public comment draft (as described in the Methods Section 1.2.1 of the IRIS PFHxS External Review Draft) or submitted in public comments received through the EPA docket[1]. The most recent ADME/PK studies were considered and incorporated as appropriate in the public comment draft, with no additional ADME/PK studies identified since its release. In accordance with charge question 1, the tables show EPA's disposition on the need to incorporate these studies into the finalized assessment and the interpreted impact of these studies on key judgments in the draft assessment (i.e., identified hazards and dose-response values, or pivotal uncertainties). The panel is asked to weigh in on EPA's disposition. Supplemental study categories included here are 'ADME' and 'mechanistic, including non-PECO exposure route.' All identified studies not meeting PECO, or the aforementioned supplemental categories are summarized in Figure 1 of this document or in the interactive HAWC visual.

Table 1. Studies meeting assessment PECO criteria

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Immune Effects in Humans				
Kaur et al. (2023)	Lit update	Antibody levels to SARS-COV2 in adults	Inverse association (beta -0.68, 95% CI -1.18, -0.18)	No. Findings are consistent with existing epidemiological evidence and have no impact on the draft immunosuppression synthesis
Porter et al. (2022)	Lit update	Antibody levels to SARS-COV2 in adults	Inverse association with IgG and neutralizing antibodies in response to	

[1] A total of 186 studies were submitted by the State of New Jersey Department of Environmental Protection and the Natural Resources Defense Council (NRDC). Of the 186 studies, 119 studies had been previously identified and can be found in the HERO database. The remaining 67 new studies were screened for PECO criteria and evaluated for potential incorporation and impact on the assessment's conclusions as stated above.

[2] For literature identified by Public Commenters, the full comments are available here: https://www.regulations.gov/docket/EPA-HQ-ORD-2021-0562. PFHxS New Studies Identified in the April 2023 Literature Search Update or Submitted to EPA during Public Comment. Diagram shows screening results for all identified studies. Information on EPA's disposition on the inclusion of these studies prior to finalizing the assessment and characterization of their impact on key assessment decisions is provided in Table 1 for studies meeting PECO and for supplemental studies on ADME, mechanistic, and non-PECO exposure routes. Refer to interactive HAWC visual for additional information.

[3]As described in charge question 1, only studies that would notably impact the primary EPA draft judgments (i.e., the health effects identified as human health hazards and the final reference values) in the Step 4 draft will be added to the Toxicological Review by EPA prior to finalization. The panel is asked to identify (with justification) any EPA decisions on incorporation or impact that are not supported.

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
			COVID vaccination (statistical significance varied based on model)	judgment (i.e., *moderate* human evidence), particularly given that two of the new studies are in adults and the draft conclusions are primarily based on studies in children.
Zhang et al. (2023b)	Lit update	Vaccine response	Inverse association with rubella antibodies (-6.48% change, 95% CI -10.69, -2.07). Inverse but not statistically significant association with mumps antibodies in sub-population with lower folate.	
Mogensen et al. (2015)	Commenter	Vaccine response	Re-analysis of Faroe Islands study, showing results when analyzed with structural equation modeling.	Multipollutant modeling results will be added to discussion of potential confounding across PFAS.
Zhang et al. (2022)	Lit update	Infectious disease	Positive association with common cold at 3-11 yrs (OR 1.31, 95% CI 1.05, 1.63) but not 12-19 yrs	No. Existing epidemiological evidence on infectious disease is inconsistent and new studies do not change the current draft synthesis judgment.
Huang et al. (2020)	Commenter	Infectious disease	No association with the number of respiratory tract infections in preschool children	
Pan et al. (2023)	Lit update	Asthma	No association with current asthma (OR 0.97, 95% CI 0.57, 1.65 in Q4 vs Q1) or wheezing. Inverse association with asthma attacks and emergency visits.	No. Existing epidemiological evidence on asthma is inconsistent and new studies do not change the current draft synthesis judgment.
Gaylord et al. (2019)	Commenter (on PFDA)	Asthma	No association with asthma diagnosis (OR 0.96, 95% CI 0.65, 1.44)	
Averina et al. (2019)	Commenter (on PFDA)	Asthma	Positive association with asthma (OR 2.18, 95% CI 1.08, 4.42 in Q4 vs Q1). No association with allergies or eczema.	
Wen et al. (2019)	Commenter	Atopic dermatitis	Positive but not statistically significant association with atopic dermatitis	
(Ammitzbøll et al., 2019)	Commenter (on PFDA)	Multiple sclerosis	No association with multiple sclerosis (2% change, 95% CI -9,15)	No. Mixed results for autoimmune conditions in new studies would not influence PFHxS draft

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Gaylord et al. (2020)	Commenter (on PFDA)	Celiac disease	Positive but not statistically significant association with celiac disease (OR 1.72, 95% CI 0.85, 3.49) with stronger effect in women (OR 3.24, 95% CI 1.04, 10.11)	evidence synthesis or integration conclusions on immune effects.
Steenland et al. (2018)	Commenter	Ulcerative colitis	Inverse association with ulcerative colitis	
Developmental Effects in Humans				
Wang et al. (2022)	Lit update	Fetal growth restriction (Birth length (BL); head circumference (HC); birthweight (BWT))	No sex-specific associations were observed for birth length (BL), birth weight (BWT) and head circumference (HC) endpoints. BL Male β = −0.080; 95%CI: −0.062, 0.222; BL Female β = −0.004; 95%CI: −0.310, 0.303. HC Male β = 0.005; 95%CI: −0.180, 0.191; HC Female β = −0.110; 95%CI: −0.345, 0.125. BWT Male β = 0.024; 95%CI: −0.140, 0.188; BWT Female β = −0.062; 95%CI: −0.291, 0.166.	No. Null results observed for fetal growth restriction endpoints (birth length, birth weight and head circumference) in both female and male neonates would not change the current draft synthesis judgment for fetal growth restriction (i.e., *slight* human evidence).
Peterson et al. (2022)	Lit update	Fetal growth restriction	No associations were evident across fetal measures in relation to PFHxS exposures.	No. Null results for fetal biometric endpoints would not change the current draft synthesis judgment for fetal growth restriction (i.e., *slight* human evidence).
Wang et al. (2023)	Lit update	Fetal growth restriction	No associations were evidence across fetal growth endpoints [Per each PFHxS log-10 unit increase, birth weight z-score -0.06 (-0.25, 0.12), birth length z-score -0.10 (-0.36, 0.17), head circumference z score 0.08 (-0.18, 0.35), ponderal index -0.04 (-0.72, 0.64), weight for length z-score 0.02 (-0.29, 0.34).	No. Null results for all fetal growth would not change the current draft synthesis judgment for fetal growth restriction (i.e., *slight* human evidence).

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Ouidir et al. (2020)	Commenter (on PFDA)	Fetal growth restriction	Per each PFHxS IQR increase, a statistically significant longitudinal decrease in head circumference (β = −0.22 mm; p-value: <0.05) and increases in longitudinal biparietal diameter (β = 0.07 mm; p-value: <0.05), and femur length (β = 0.12 mm; p-value: <0.001) were detected. Results were null for abdominal circumference (β = 0.11 mm), occipital-frontal diameter changes (β = −0.04 mm) and estimated fetal growth (β = 3.27 g) (*p*-value/Cis not provided).	No. Study population was previously reported in a publication already in the assessment Buck Louis et al. (2018). New results for longitudinal in utero measurements from ultrasonography would not change the current draft synthesis judgment.
Hu et al. (2021)	Commenter	Fetal growth restriction	Per each PFHxS 2-fold increase, a 6.7 g (95% CI -11.4, 24.8) increase in birth weight, attenuated with adjustment for co-pollutants.	No. Study population was previously reported in a population already in the assessment and new results would not change the current draft synthesis judgment.
Kalloo et al. (2020)	Commenter	Fetal growth restriction, gestational age	N/A. Duplicative results from other publications.	No. The anthropometrics measures of fetal growth and gestational duration reported in this study population (HOME study) were previously reported in a publication already in the assessment (Shoaff, 2018, 4619944). We also previously demonstrated in Appendix C that single PFHxS vs. multi-PFAS models were comparable.
Mwapasa et al. (2023)	Lit update	Fetal growth restriction, gestational age	Per each $\log_{10}$-unit PFHxS increase, results were largely null across the overall population and both sexes, although boys showed lower birth weight z-scores while girls had larger head circumference z-scores. All of these results had confidence intervals that included the null value demonstrating a lack of statistical significance.	No. Null findings of fetal growth restriction would not change the current draft synthesis judgment (i.e., *slight* human evidence).

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Petroff et al. (2023)	Lit update	Gestational age	No association between PFHxS exposure and gestational age (ß = 0.04 ± 0.21; *p*=0.85).	No. Null results for gestational age would not change the current draft human evidence synthesis judgment for gestational duration (i.e., *slight* human evidence).
Yu et al. (2022)	Lit update	Preterm birth	Results were mixed with a non-significant increase in risk seen for untransformed data (OR=1.76; 95%CI: 0.91, 3.40 per each ng/mL increase) only; transformed results were null (OR=0.93; 95%CI: 0.80, 1.08 per each ln-unit increase).	No. Small increased risks here along with the null results in Padula et al. (2023) and Liao et al. (2022b) would not change the current draft synthesis judgment for gestational duration.
Liao et al. (2022b)	Lit update	Preterm birth	Results were mixed with a statistically significant decrease in preterm birth per each log10 increase (OR=0.73; 95%CI: 0.39, 1.38) driven by tertile 3 (OR=0.60; 95%CI: 0.37, 0.98); results were null for tertile 2 (OR=0.97; 95%CI: 0.63, 1.50) relative to tertile 1.	No. Inconsistent new results on gestational duration in the new studies including decreased risk reported here combined with increased risk by Yu et al. (2022) and null results in Padula et al. (2023) above would not change the current draft synthesis judgment for gestational duration (i.e., *slight* human evidence).
Padula et al. (2023)	Lit update	Fetal growth restriction, gestational duration	No associations were evident across fetal growth and gestational duration endpoints [gestational age β= 0.02; 95%CI: −0.19, 0.23; birth weight for gestational age β= −0.06; 95%CI: −0.18, 0.06; term low birth weight OR= 1.14; 95%CI: 0.46, 2.84; small for gestational age OR= 1.25; 95%CI: 0.84, 1.87; large for gestational age OR= 0.86; 95%CI: 0.59, 1.25; preterm birth OR= 0.97; 95%CI: 0.61, 1.55.	No. Null results for all fetal growth and gestational duration endpoints would not change the current draft judgment for either gestational duration or fetal growth restriction (i.e., *slight* human evidence).
Hong et al. (2022)	Lit update	Spontaneous abortion	Inverse association (OR=0.05; 95% CI: 0.00, 7.36)	No. Updated analysis of study that is already included in the draft assessment.

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Li et al. (2022a)	Lit update	Anogenital distance	Positive association with two AGD measures (p<0.05)	No. New study adds to existing inconsistency in the AGD evidence and would not change the draft synthesis judgment.
Developmental Effects in Animals				
Yao et al. (2023)	Commenter	Fetal viability in animals	Increased fetal death in mice exposed to highest dose (0.3 mg/kg-d)	Yes. Findings are supportive of results from a separate animal study that is cited in the draft Toxicological Review. These new findings are preliminarily interpreted to strengthen the animal evidence synthesis judgment from *indeterminate* to *slight* (dependent on formal study evaluation and incorporation into the synthesis). However, these new findings do not change the overall evidence integration judgment (i.e., *evidence suggests*).
Hepatic Effects in Humans				
Borghese et al. (2022)	Lit update	Liver enzymes	Positive association with AST, GGT, and ALP, positive but not statistically significant association with ALT and bilirubin	No. New studies are consistent with the existing studies and would not change the draft synthesis judgment (i.e., *slight* human evidence).
Liao et al. (2023)	Lit update	Liver enzymes	Positive association with bilirubin but not ALT, AST, or GGT	
Kim et al. (2023b)	Lit update	Liver enzymes	Positive but not statistically significant associations with ALT, AST, and GGT	
Yao et al. (2020)	Commenter (on PFDA)	Liver enzymes	Positive association with ALT, AST, GGT (statistically significant for GGT)	
Salihović et al. (2019)	Commenter (on PFDA)	Bile acid levels (liver)	Inverse correlations with most bile acids (statistically significant for GDCA)	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Rantakokko et al. (2015)	Commenter (on PFDA)	Non-alcoholic fatty liver disease	Inverse association with lobular inflammation (OR 0.02, 95% CI <0.01, 0.53 for 2–4 foci per 200× field)	No. While there are no studies of clinical liver disease available for PFHxS in the current draft, the new studies are inconsistent and would not change the draft synthesis judgment of *slight* for hepatic effects.
E et al. (2023)	Lit update	Liver disease	No association with liver problems (OR 0.97, 95% CI 0.72, 1.30). Positive but not statistically significant association with ALT.	
Nilsson et al. (2022)	Lit update	Liver problems	Positive association with non-alcoholic fatty liver disease in women but not men, with strongest association in postmenopausal women (OR 2.50, 95% CI 1.29, 4.85 in Q4 vs Q1)	
Cancer in Humans				
Feng et al. (2022a)	Lit update	Breast cancer	No association with breast cancer (OR = 0.93, 95% CI: 0.79, 1.09) per unit increase in ln-transformed plasma PFHxS levels.	No. Inconsistent results across the new studies showing increased risk (note: this study reports on the same study population as a publication already in the assessment), decreased risk, and no association between PFHxS and breast cancer do not change the draft synthesis judgment (i.e., *indeterminate* human evidence; two studies on breast cancer were synthesized in the draft, one study finding significantly increased risk of breast cancer among women <= 50 years of age who were estrogen receptor positive; and non-significantly decreased risk of breast cancer among women who were estrogen receptor negative and > 50 years of age, and another study reporting significantly decreased risk for some genotypes).
Li et al. (2022b)	Lit update	Breast cancer	Decreased risk for breast cancer (OR = 0.73, 95% CI: 0.63, 0.87) per SD increase in ln-transformed PFHxS from the adjusted model – without LASSO (see Table S3).	
Wielsøe et al. (2018)	Commenter (on PFDA)	Breast cancer	Increased risk for breast cancer (OR 5.45, 95% CI 1.26, 23.8) in high vs. low PFHxS exposure for one genotype).	
Lee et al. (2020)	Commenter (on PFDA)	Breast cancer	No association of PFHxS with mammographic density, a strong predictor of breast cancer (beta -0.02, *p*-value 0.95).	
Cohn et al. (2020)	Commenter	Breast cancer	No association with breast cancer (quantitative result not reported).	
Goodrich et al. (2022)	Lit update	Liver cancer	No association of PFHxS with liver cancer (OR = 1.10, 95% CI: 0.56, 2.30) for PFHxS greater than the 90th% vs less than 90th%.	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Shearer et al. (2021)	Commenter (on PFDA)	Renal cancer	Increased risk of renal cell carcinoma with PFHxS per unit increase in log_2-transformed serum PFHxS (OR=1.27; 95% CI: 1.03, 1.56) that attenuated when controlling for other PFAS (OR=1.12; 95% CI: 0.88, 1.43).	The only study reporting on liver cancer did not find an association with PFHxS and would not influence the draft synthesis judgment. The only study of renal cancer reported a significant positive association that dissipated when controlling for other PFAS and would not influence the draft synthesis judgment. The epidemiologic evidence on PFHxS and the risk of cancer remains indeterminate and, overall, there remains ***inadequate information to assess carcinogenic potential;*** the new human studies are not impactful.
Neurodevelopmental Effects in Humans				
Luo et al. (2022a)	Lit update	Broad neurodevelopmental scale	Inverse but not statistically significant association with cognitive, language, motor, and social-emotional scores, but statistically significant positive association with adaptive behavior score	No. There is inconsistency for neurodevelopmental effects in the current draft, and the new studies showing overall mixed but several positive associations with PFHxS would not influence the draft synthesis judgment of *slight* evidence.
Oh et al. (2022)	Lit update	Autism, developmental delay	Positive but not statistically significant associations with autism spectrum disorder and developmental delay	
Zhou et al. (2023)	Lit update	Broad neurodevelopmental scale	Inverse association with communication and motor at 6 mos but inconsistent findings for other measures (problem solving, personal-social) and other visits (2, 12, and 24 mos)	
Li et al. (2023c)	Lit update	Broad neurodevelopmental scale	Positive association with persistently low trajectory for communication (p<0.05), gross motor, problem solving ability (p<0.05), and personal-social skills, but not fine motor	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Oulhote et al. (2019)	Commenter (on PFDA)	Broad neurodevelopmental scale	Positive association with Boston Naming Test. No association with Strengths and Difficulties Questionnaire.	
van Larebeke et al. (2022)	Lit update	Broad neurodevelopmental scale	Inverse (favorable) association with incorrect responses on the Continuous Performance Test but not other test results	
Xie et al. (2022)	Lit update	Neurobehavior	No association with behavior including externalizing problems	
Ames et al. (2023)	Lit update	Autism	No association with Social Responsiveness Scale score	
Kim et al. (2023a)	Lit update	ADHD scale	Positive though non-monotonic association with ADHD rating scale at 8 yrs, dependent on age at exposure measurement and sex	
Human Male Reproductive				
Luo et al. (2022b)	Lit update	Semen parameters	No association with sperm concentration of motility	No. Evidence is inconsistent in existing studies and the new studies would not influence the draft synthesis judgment (i.e., *indeterminate* human evidence).
Ma et al. (2021)	Commenter (on PFDA)	Semen parameters	No association sperm concentration, motility, or morphology	
Zhang et al. (2011)	Commenter	Infertility	Lower concentrations of PFHxS in infertile men than worker controls in crude analysis	
Rivera-Núñez et al. (2023)	Lit update	Reproductive hormones	Positive association with T (p<0.05), no association with free T, E1, E2, E3	No. Evidence is inconsistent in existing studies and the new studies would not influence the draft synthesis conclusion of *indeterminate* evidence.
Guo et al. (2023)	Lit update	Reproductive hormones	No association with testosterone or estradiol (included boys and girls)	
Wang et al. (2023)	Lit update	Reproductive hormones	Positive association with estradiol but not testosterone (included boys and girls)	
Nian et al. (2020)	Commenter (on PFDA)	Reproductive hormones	No association with total testosterone (beta 0.079, 95% CI -0.009, 0.166 per ln-unit change), FSH, or LH	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Human Female Reproductive				
Hong et al. (2022)	Lit update	In vitro fertilization outcomes	No association with oocyte maturation rate, fertilization rate, high quality embryo rate. Inverse but not statistically significant (OR=0.60, 95% CI 0.12, 2.96) for clinical pregnancy	No. Evidence of an association with fecundity and infertility is inconsistent across new studies and was similarly inconsistent across existing studies. Thus, the new studies would not change the draft synthesis judgment of *indeterminate* human evidence.
Cohen et al. (2023)	Lit update	Fecundity, pregnancy	No association with time to pregnancy or odds of clinical pregnancy	
Luo et al. (2022c)	Lit update	Fecundity, infertility	Lower odds of infertility (OR 0.61, 95% CI 0.45, 0.82) and higher fecundability	
Tan et al. (2022)	Lit update	Infertility	Lower odds of infertility (non-monotonic across quartiles and not statistically significant)	
(Whitworth et al., 2016)	Commenter (on PFDA)	Fecundity	No association (FR 0.97, 95% CI 0.90, 1.1)	
Ma et al. (2021)	Commenter (on PFDA)	In vitro fertilization outcomes, pregnancy	Fewer zygotes and good quality embryos with higher exposure. No association with clinical pregnancy.	
Petro et al. (2014)	Commenter	In vitro fertilization outcomes	Positive association with fertilization rate in crude analysis	
Wang et al. (2019)	Commenter (on PFDA)	Polycystic ovarian syndrome	Positive but not statistically significant association with PCOS-related infertility (OR 2.08, 95% CI 0.88, 4.93 in 3rd vs. 1st tertile)	No. Existing evidence on gynecological conditions is inconsistent and there is considerable uncertainty due to potential reverse causation. The new study does not inform this uncertainty and would not change the draft synthesis judgment
Rivera-Núñez et al. (2023)	Lit update	Reproductive hormones	Positive association with E1, E2, E3 (p<0.05), no association with T, FT	No.

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Nian et al. (2020)	Commenter (on PFDA)	Reproductive hormones	No association with total testosterone (beta -0.029, 95% CI -0.090, 0.032 per ln-unit change), FSH, or LH	New studies on reproductive hormones are inconsistent and would not change the current draft synthesis judgment.
Liu et al. (2020a)	Commenter (on PFDA)	Reproductive hormones	Positive association with estradiol (6.8% change, 95% CI 2.2, 11.6)	
Ding et al. (2020)	Commenter	Menopause	No association with timing of incident natural menopause	
Lin et al. (2022)	Lit update	Postpartum hemorrhage	Higher odds of postpartum hemorrhage (OR 3.42, 95% CI 1.45, 8.07)	Yes. This is a new outcome not reported in other studies with a large effect size, so evidence will be evaluated and considered for inclusion in the assessment.
Kim et al. (2020)	Commenter	Breastfeeding	Inverse association in crude analysis with PFHxS modeled as outcome	Yes. Given the inferred importance of this outcome and concerns for effects of other PFAS on this outcome, evidence for lactation duration will be evaluated and considered for inclusion in the assessment.
Papadopoulou et al. (2016)	Commenter	Breastfeeding	Positive but not statistically significant association with breastfeeding duration	
Urinary Effects in Humans				
Nilsson et al. (2022)	Lit update	Kidney disease, urate	No association with kidney disease (OR 0.90, 95% CI 0.76, 1.08) or urate	No. Existing studies are generally consistent but predominantly low confidence with considerable uncertainty due to potential reverse causation, leading to a draft synthesis judgment of *slight* human evidence. The new studies do not inform this uncertainty and would not change the synthesis judgment.
Liang et al. (2023)	Lit update	Glomerular filtration rate	Higher GFR (not statistically significant)	
Sood et al. (2019)	Commenter (on PFDA)	Glomerular filtration rate	Inverse but not statistically significant association with eGFR (beta -10.3, 95% CI -23.6, 3.0)	
Pan et al. (2017)	Commenter	Glomerular filtration rate	Inverse association with GFR in crude analysis	
Feng et al. (2022b)	Lit update	Hyperuricemia	No association with hyperuricemia	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Arrebola et al. (2019)	Commenter (on PFDA)	Hyperuricemia	Positive but not statistically significant association with hyperuricemia (OR 1.33, 95% CI 0.70, 2.54)	
Yao et al. (2020)	Commenter (on PFDA)	Uric acid	Positive association with uric acid (beta 8.44, 95% CI 2.17, 15.09)	
Cardiometabolic Effects in Humans				
Haug et al. (2023)	Lit update	Serum lipids	No association with HDL or LDL cholesterol	No. For serum lipids, the overall mixed findings but with some notable positive associations with PFHxS from the new studies would not change the current draft synthesis judgment (i.e., *slight* human evidence).
Donat-Vargas et al. (2019b)	Commenter (on PFDA)	Serum lipids, hypertension	No association with total cholesterol, triglycerides, or hypertension	
Batzella et al. (2022)	Lit update	Serum lipids	Positive association with total cholesterol (beta 1.74, 95% CI 1.36, 2.13) and LDL-cholesterol	
Morgan et al. (2023)	Lit update	Serum lipids	No association with total cholesterol or LDL-cholesterol (crude analysis only)	
Rosen et al. (2022)	Lit update	Serum lipids	Positive but not statistically significant association with total cholesterol, LDL, and triglycerides	
Fan et al. (2020)	Commenter	Serum lipids	No association with total or LDL cholesterol or triglycerides	
Li et al. (2019)	Commenter	Serum lipids	No association with total cholesterol or triglycerides	
Nilsson et al. (2022)	Lit update	Serum lipids, blood pressure, cardiovascular disease	Positive association with total cholesterol and LDL-cholesterol in cross-sectional but not prospective analysis. No association with high blood pressure (OR 0.92, 95% CI 0.83, 1.03) or cardiovascular disease (OR 0.96, 95% CI 0.81, 1.15)	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Fassler et al. (2019)	Commenter	Serum lipids, adiposity, insulin resistance	No association with BMI, insulin resistance, or serum lipids	
Yao et al. (2020)	Commenter (on PFDA)	Serum lipids, blood glucose	Positive association with total cholesterol (beta 6.98, 95% CI 3.06, 11.14), triglycerides, and blood glucose	
Chen et al. (2020)	Commenter	Serum lipids, insulin resistance, adiposity	Positive but not statistically significant association with total and LDL cholesterol and blood glucose. Inverse association with BMI and body fat percent.	
Jain (2014)	Commenter	Serum lipids, adiposity	No association with total cholesterol, triglycerides, or BMI	
Ding et al. (2022)	Lit update	Hypertension	No association with hypertension (HR 0.98, 95% CI 0.93, 1.04 per 2-fold increase)	
Mitro et al. (2020a)	Lit update	Blood pressure	No association with blood pressure, BMI, waist circumference, mid-upper arm circumference, or skinfold thickness	
Ma et al. (2019)	Commenter	Blood pressure	No association with blood pressure	
Sood et al. (2019)	Commenter (on PFDA)	Blood pressure	No association with blood pressure (beta 0.3, 95% CI -0.1, 0.7)	
Lind et al. (2018)	Commenter (on PFDA)	Carotid artery intima-media thickness	Positive association with IMT thickness (beta 0.015, 95% CI 0.005, 0.0025)	No. These results support coherence with serum lipids but would not change the current draft synthesis judgment.
Li et al. (2023b)	Lit update	Cardiovascular disease	No association with acute coronary syndrome	No.

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Hutcheson et al. (2020)	Commenter	Stroke	Inverse association with stroke in participants with diabetes (OR 0.75, 95% CI 0.64-0.88), no association in participants without diabetes	New studies contribute to existing inconsistency and would not change the current draft synthesis judgment.
Yang et al. (2022)	Lit update	Gestational hypertension	Lower odds of gestational hypertension (OR 0.66, 95% CI 0.35, 1.24) and lower continuous blood pressure	No. New studies contribute to existing inconsistency and would not change the current draft synthesis judgment (i.e., mixed findings for cardiovascular risk factors did not contribute to the *slight* human evidence judgment).
Huo et al. (2020)	Lit update	Gestational hypertension	No association with gestational hypertension (OR 0.80, 95% CI 0.44, 1.47) or preeclampsia (OR 1.05, 95% CI 0.60, 1.83)	
Zhu and Bartell (2022)	Lit update	Gestational hypertension	Small positive association with hypertensive disorders in pregnancy (OR 1.03, 95% CI 1.02, 1.04)	
Xu et al. (2022)	Lit update	Gestational diabetes	Inverse association with gestational diabetes (OR 0.09, 95% CI 0.03, 0.22 in third tertile), inverse association with continuous glucose levels in oral glucose tolerance test	No. Existing studies are inconsistent and new studies would not change the current draft synthesis judgment (i.e., mixed findings for cardiovascular risk factors did not contribute to the *slight* human evidence judgment).
Zhang et al. (2023a)	Lit update	Gestational diabetes	Positive association with gestational diabetes (OR 3.46, 95% CI 1.64, 6.30 in 3rd tertile)	
Xu et al. (2020a)	Lit update	Gestational diabetes	No association with gestational diabetes (OR 0.79, 95% CI 0.46, 1.31 in Q4 vs Q1)	
Preston et al. (2020)	Lit update	Gestational diabetes	No association with gestational diabetes	
Liu et al. (2019)	Commenter	Gestational diabetes	No association with gestational diabetes in crude analysis	
Li et al. (2020)	Commenter (on PFDA)	Gestational blood glucose	Positive but not statistically significant association with blood glucose in oral	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
			glucose tolerance test (beta 0.07, 95% CI -0.06, 0.21)	
Dunder et al. (2023)	Lit update	Blood glucose	No association with blood glucose	No. Existing and new studies are primarily null, and new studies would not change the current draft synthesis judgment.
Christensen et al. (2016)	Commenter (on PFDA)	Diabetes	No association with diabetes (OR 0.98, 95 % CI 0.69, 1.16) or pre-diabetes (OR 1.00, 95% CI 0.77, 1.16)	
Park et al. (2022)	Lit update	Diabetes	Positive association with incident diabetes (OR 1.58, 95% CI 1.13, 2.21 in T3 vs T1) but not monotonic across tertiles	
Cardenas et al. (2019)	Commenter	Diabetes	No association with incident diabetes in a cohort of participants from a diabetes prevention trial.	
Zong et al. (2016)	Commenter	Diabetes	No association with diabetes	
Donat-Vargas et al. (2019a)	Commenter (on PFDA)	Diabetes risk, insulin resistance	No increase in diabetes risk or HOMA-IR	
Kim et al. (2015)	Commenter (on PFDA)	Insulin resistance	No association with HOMA (beta -0.08, 95% CI -0.68, 0.52)	
Mehta et al. (2021)	Commenter (on PFDA)	Insulin resistance	No association with blood glucose or HOMA-IR	
Bassler et al. (2019)	Commenter	Insulin resistance	Inverse association with insulin	
Brosset and Ngueta (2022)	Lit update	Glycemic control	No association with poor glycemic control	
Ye et al. (2021)	Commenter (on PFDA)	Metabolic syndrome	No association with metabolic syndrome (OR 1.02, 95% CI 0.93, 1.13) or blood glucose, blood pressure, serum lipids, or waist circumference	No. Existing and new studies are primarily null, and new studies would not change the current draft synthesis judgment.
Leary et al. (2020)	Commenter	Metabolic syndrome	No association with metabolic syndrome in firefighters	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Schillemans et al. (2022)	Lit update	Adiposity	No association with BMI z-score	No. Existing and new studies are primarily null, and new studies would not change the current draft synthesis judgment. Notably, the majority of new studies only indirectly examine PFHxS concentrations and/or involve crude analyses without adjustment for potential confounders (some or most would be judged as *uninformative* during formal study evaluations).
Zeng et al. (2023)	Lit update	Adiposity	No association with BMI z-score trajectory	
(Harris et al., 2017)	Commenter (on PFDA)	Adiposity	Lower PFHxS levels in obese (-8.0% difference, 95% CI -26.6, 15.2 for obese vs normal)	
Ji et al. (2012)	Commenter (on PFDA)	Adiposity	Higher PFHxS concentrations in overweight participants, but no statistical analysis	
Pirard et al. (2020)	Commenter (on PFDA)	Adiposity	No association with BMI (quantitative results not presented)	
Liu et al. (2020b)	Commenter (on PFDA)	Adiposity	No association with BMI	
Kim et al. (2020)	Commenter	Adiposity	No association with pre-pregnancy BMI in crude analysis with PFHxS modeled as outcome	
Bjerregaard-Olesen et al. (2016)	Commenter	Adiposity	No association with pre-pregnancy BMI in analysis with PFHxS modeled as outcome	
Chang et al. (2020)	Commenter	Adiposity	Inverse association with BMI in analysis with PFHxS modeled as outcome	
Cardenas et al. (2018)	Commenter	Adiposity	Positive but not statistically significant association with some measures of adiposity including skinfold thickness and subcutaneous fat	
Colles et al. (2020)	Commenter	Adiposity	No association with BMI in analysis with PFHxS modeled as outcome	
Eick et al. (2021)	Commenter	Adiposity	No association with BMI in crude analysis	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Fisher et al. (2016)	Commenter	Adiposity	No association with BMI in descriptive analysis	
Han et al. (2018)	Commenter	Adiposity	No association with BMI (quantitative results not reported)	
Hölzer et al. (2008)	Commenter	Adiposity	No association with BMI in crude analysis	
Huang et al. (2019)	Commenter	Adiposity	No association with BMI in analysis with PFHxS modeled as outcome	
Koponen et al. (2018)	Commenter	Adiposity	No association with BMI in crude correlation analysis (quantitative result not reported)	
Lewin et al. (2017)	Commenter	Adiposity	No association with BMI in crude analysis	
Mehta et al. (2020)	Commenter	Adiposity	No association with BMI	
Nair et al. (2021)	Commenter	Adiposity	No association with BMI in crude analysis	
Ramli et al. (2020)	Commenter	Adiposity	No association with BMI in analysis with PFHxS modeled as outcome	
Rylander et al. (2009)	Commenter	Adiposity	No association with BMI (quantitative result not reported)	
Tsai et al. (2018)	Commenter	Adiposity	No association with BMI (unadjusted means)	
Yang et al. (2019)	Commenter	Adiposity	Higher PFHxS concentration with higher BMI (unadjusted means)	
Tian et al. (2019)	Commenter	Adiposity	No association with BMI or waist circumference	
Brantsæter et al. (2013)	Commenter	Adiposity, gestational weight gain	Higher PFHxS concentrations with higher BMI (unadjusted means), no association with weight change	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Mitro et al. (2020b)	Commenter	Gestational weight gain	No association with gestational weight gain; positive but not statistically significant association with postpartum weight retention	
Thyroid Effects in Humans				
Jensen et al. (2022)	Lit update	Thyroid hormones	No association with free T4, positive but non-monotonic and not statistically significant association with TSH (beta 4.05, 95% CI -1.58, 10.00)	No. Existing and new studies on thyroid hormones are mixed but primarily null and new studies would not change the current draft synthesis judgment (i.e., *indeterminate* human evidence).
Derakhshan et al. (2022)	Lit update	Thyroid hormones	Positive association with free T4 (beta 0.13, 95% CI -0.01, 0.28) but no association with TSH or free T3	
Li et al. (2023a)	Lit update	Thyroid hormones	No association with TSH or free T4	
Tillaut et al. (2022)	Lit update	Thyroid hormones	No association with free T4, free T3, or TSH	
Wang et al. (2023)	Lit update	Thyroid hormones	Positive association with total T4 but not other thyroid hormones	
Jain and Ducatman (2019)	Commenter (on PFDA)	Thyroid hormones	Positive association with Total T3 in participants at higher glomerular filtration stages.	
Dufour et al. (2020)	Commenter (on PFDA)	Thyroid disease	Inverse association with hyperthyroidism (OR 0.14, 95% CI 0.03, 0.63)	
(Christensen et al., 2016)	Commenter (on PFDA)	Thyroid disease	Inverse association with thyroid disease (OR 0.59, 95% CI 0.20, 1.06)	
Nilsson et al. (2022)	Lit update	Thyroid problems, thyroid hormones	No association with thyroid problems (OR 0.94, 95% CI 0.73, 1.21). Inverse but not statistically significant association with T4 but not T3 or TSH.	
Other Effects in Humans				

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Højsager et al. (2022)	Lit update	Bone mineral density	Inverse association with bone mineral content and density (p>0.05), stronger in boys	No. Existing studies are inconsistent, and new evidence is similarly inconsistent; thus, the new evidence would not change the draft synthesis judgment of *indeterminate* human evidence.
Zhao et al. (2022)	Lit update	Bone mineral density	Inverse association (p>0.05) with femur bone mineral density in women without menopause/hysterectomy	
Colicino et al. (2020)	Lit update	Bone mineral density	No association with lumbar spine or femur density	
Xiong et al. (2022)	Lit update	Bone mineral density	Positive association with femur density and inverse association with lumbar spine density in girls only	
Blomberg et al. (2022)	Lit update	Bone mineral density	No association with bone mineral density in children to 9 yrs	
Fan et al. (2023)	Lit update	Bone mineral density, osteoporosis	Positive but not statistically significant association with osteoporosis (OR 1.23, 95% CI 0.95, 1.60), inverse association with bone mineral density (beta -0.23, 95% CI -0.33, -0.12)	
Shiue (2015d)	Commenter (on PFDA)	Oral health	No association with teeth health, ache, tooth loss	
Liao et al. (2022a)	Lit update	Hematology	Positive but not statistically significant association with gestational anemia in the 1st and 3rd but not 2nd trimesters. No association with hemoglobin concentration during pregnancy	No. Inconsistent results in new studies. The new evidence would not change the draft synthesis judgment of *indeterminate* human evidence (currently one *uninformative* study in assessment).
Cui et al. (2022)	Lit update	Hematology	Positive association with hematocrit (3.51% change, 95% CI 1.82, 5.24) and hemoglobin (3.14% change, 95% CI 1.33, 4.99) during pregnancy	

Reference	Source[2]	Health outcome	Results summary	EPA disposition on incorporation and characterization of impact[3]
Liu et al. (2022)	Lit update	Hematology	No association with white blood cells and lymphocytes	
Shiue (2015a)	Commenter (on PFDA)	Neurologic; Remembering condition	No association with difficulty remembering (RR 0.45, 95% CI 0.25–0.81 for >3 times per wk)	No. Lack of association in both existing and new studies for several isolated nervous system outcomes; thus, the new evidence would not change the draft synthesis judgment of *indeterminate* human evidence.
Shiue (2015b)	Commenter (on PFDA)	Neurologic; Depression	No association with adult depression	
Shiue (2015c)	Commenter (on PFDA)	Neurologic; Hearing disturbance	No association with trouble hearing	
(Gaylord et al., 2019)	Commenter (on PFDA)	Pulmonary function	No association with FEV or FVC (FEV1 beta -0.01, 95% CI -0.10, 0.08, FVC beta 0.03, 95% CI -0.08, 0.13)	No. Lack of association in available studies, the new evidence does not justify development of a new hazard section.
Shi et al. (2023)	Lit update	Pulmonary function	No association with forced expiratory volume or forced volume capacity.	

Table 2. Studies meeting select categories of supplemental evidence

Reference	Source	Assessment Topic	Description or Results	EPA disposition on incorporation and characterization of impact
ADME/PK studies				
Vogs et al. (2019)	Lit Update	ADME	Toxicokinetics of PFAS uptake in zebrafish	No. While these results may be of interest in further work in zebrafish, these results are not directly applicable to humans or mammalian model species.
Qin et al. (2023)	Lit Update	ADME	Characterization of PFHxS protein binding	No. Results do not change draft judgments or provide essential insights into potential mechanisms of PFHxS-induced toxicity.
Mechanistic, including Non-PECO Routes of Exposure				

Reference	Source	Assessment Topic	Description or Results	EPA disposition on incorporation and characterization of impact
Stoker et al. (2023)	Lit Update	Thyroid	PFOS & PFHxS found to be NIS inhibitors	No. Results do not change the draft evidence integration judgment (**evidence indicates**) or provide essential insights into potential mechanisms of PFHxS-induced thyroid toxicity.
Buckalew et al. (2020)	Lit Update	Thyroid	Evaluation of PFAS sodium-iodide symporter (NIS) inhibitors	
Vongphachan et al. (2011)	Lit Update	Neurodevelopmental; Thyroid	PFAS effects on mRNA expression levels of thyroid-responsive genes in avian primary cultures	No. Results do not change draft judgments or provide essential insights into potential mechanisms of PFHxS-induced neurodevelopmental or thyroid effects
Phelps et al. (2023)	Lit Update	Immune	PFHxS and GenX suppressed the respiratory burst in zebrafish and human neutrophil-like cell line.	No. Results do not change the draft evidence integration judgment (**evidence indicates**) or provide essential insights into potential mechanisms of PFHxS-induced immunotoxicity.
Park et al. (2021)	Lit Update	Immune	Examination of the effects of PFAS including, PFHxS, on mast cell-mediated inflammatory responses using in vitro mouse bone marrow-derived mast cells (BMMCs) and human mast cells (HMC-1) and in vivo mice model.	
Hvizdak et al. (2023)	Lit Update	Developmental	Study demonstrates that of the six PFAS tested, PFOA, PFOS, PFNA, and PFHxS bind to and inhibit CYP3A7. CYP3A7 is responsible for facilitating a variety of	No. Results do not change draft judgments or provide essential insights into potential mechanisms of PFHxS-induced developmental effects.

Reference	Source	Assessment Topic	Description or Results	EPA disposition on incorporation and characterization of impact
			reactions essential for fetal development.	
Gundacker et al. (2022)	Lit Update	Developmental	Potential MOAs of reduced birthweight associated with PFAS identified.	
Annunziato et al. (2019)	Lit Update	Developmental	PFAS developmental effects on behavioral, morphometric and gene expression endpoints in zebrafish.	
Liu et al. (2020d)	Lit Update	Developmental	Evaluation the toxicity of several short chain PFAS in hMSC. Results demonstrated cytotoxic and potential developmental toxicity.	
Xu et al. (2021)	Lit Update	Developmental	Lipid profiling during different stages of zebrafish development to understand PFHxS toxicity	
Dasgupta et al. (2020)	Lit Update	Developmental	PFAS affect development in zebra fish	
Gaballah et al. (2020)	Lit Update	Developmental; developmental neurotoxicity	Evaluation of developmental and neurodevelopmental toxicity from PFAS exposure	No. Results do not change draft judgments or provide essential insights into potential mechanisms of PFHxS-induced developmental effects and or neurodevelopmental effects.
Solan et al. (2023)	Lit Update	Neurotoxicity/ hepatotoxicity	Every short-chain PFAS evaluated, except for PFHxS, increased the activity of at least one antioxidant enzyme.	No. Null results do not change the draft evidence integration judgments for nervous system (for developmental exposure, **evidence suggests**; in adults, **inadequate evidence**) or liver (**evidence suggests**) effects

Reference	Source	Assessment Topic	Description or Results	EPA disposition on incorporation and characterization of impact
				or provide essential insights into potential mechanism(s) of PFHxS-induced toxicity.
Menger et al. (2020)	Lit Update	Neurotoxicity	PFHxS behavioral effects and bioaccumulation in zebrafish	No. Results do not change draft judgments for nervous system (for developmental exposure, **evidence suggests**; in adults, **inadequate evidence** or provide essential insights into potential mechanisms of PFHxS-induced neurotoxicity effects.
Berntsen et al. (2018)	Lit Update	Neurotoxicity	PFAS effects on viability and NMDA receptor activation	
Rericha et al. (2021)	Lit Update	Neurodevelopmental	PFAS effects on zebrafish behavior	No. Results do not change draft judgments or provide essential insights into potential mechanisms of PFHxS-induced neurodevelopmental effects
Behr et al. (2018)	Lit Update	Reproductive toxicity/ Endocrine	Examination of endocrine properties of various PFAS including PFHxS	No. Results do not change draft judgments or provide essential insights into potential mechanisms of PFHxS-induced reproductive effects.
Leclercq et al. (2022)	Lit Update	Female reproductive/ Developmental	PFAS exposure during IVM, PFHxS tended to result in higher blastocyst rates on day 5 post fertilization and on day 6 post fertilization as well as in higher apoptosis rates in blastocysts. PFHxS resulted in higher total cell counts in blastocysts.	No. Results do not change the draft evidence integration judgments or provide essential insights into potential mechanisms of PFHxS-induced developmental or female reproductive effects.
Hallberg et al. (2022)	Lit Update	Female reproductive	PFHxS induction of phenotypic, transcriptomic, and DNA methylation in bovine oocytes	No. Results do not change draft judgments or provide essential insights into potential mechanisms of PFHxS-induced female reproductive effects.
Hallberg et al. (2021)	Lit Update	Female reproductive	PFHxS effects on bovine preimplantation in-vitro	

Reference	Source	Assessment Topic	Description or Results	EPA disposition on incorporation and characterization of impact
Qiu et al. (2020)	Lit Update	Female Repro; Other	PFAS binding to estrogen receptors	No, results do not influence draft judgments or provide key insights into key science issues, nor do they provide essential insights into potential mechanisms of PFHxS-induced effects.
Fragki et al. (2023)	Lit update	Hepatic	PFAS, including PFHxS may lead to interference of hepatic gene expression and lipid metabolism.	No. Results do not change draft judgments or provide essential insights into potential mechanisms of PFHxS-induced hepatic effects.
Søderstrøm et al. (2022)	Lit Update	Hepatic	PFAS modulation of PPAR-signaling pathway in Atlantic cod fish.	
Evans et al. (2022)	Lit Update	Hepatic	Characterization of PPAR alpha and hER binding to PFAS	
Ishibashi et al. (2019)	Lit Update	Hepatic	PFAS binding to human and Balkal seal PPAR alpha	
Ojo et al. (2020)	Lit Update	Hepatic	PFAS mixtures effects on HepG2 cells	
Ojo et al. (2021)	Lit Update	Hepatoxicity	Evaluation of oxidative stress caused by individual and combined PFAS on human liver cells	
Bjork et al. (2021)	Lit Update	Hepatotoxicity	Evaluation of binary mixtures of PFAS on molecular responses. PPAR alpha activation was observed in FAO rat hepatoma cells exposed to binary mixtures of PFAS.	
Ishibashi et al. (2011)	Lit Update	Hepatic	PPAR alpha activation in Baikal seal by PFAS	

Reference	Source	Assessment Topic	Description or Results	EPA disposition on incorporation and characterization of impact
Wallace et al. (2013)	Lit Update	Hepatic	PFAS structure activity relationships and interference with mitochondrial respiration in rat liver	
Sørli et al. (2020)	Lit Update	Respiratory Toxicity/Other	in vitro models to assess toxicity to the respiratory system; i) a lung surfactant (LS) function assay to assess the acute inhalation toxicity potential, and ii) a cell model with human bronchial epithelial cells to study pro-inflammatory potential and modulation of inflammatory responses. PFHxS, PFOA and PFOS can inhibit LS function.	No, results do not influence draft judgments or provide key insights into key science issues, nor do they provide essential insights into potential mechanisms of PFHxS-induced respiratory or other effects.
Qin et al. (2020)	Lit Update	Cardiometabolic effects; Diabetes	Stimulation of insulin secretion by Islet beta cells cause by PFAS	No. Results do not change draft judgments or provide essential insights into potential mechanisms of PFHxS-induced cardiometabolic effects
Qin et al. (2023)	Lit Update	ADME	Characterization of PFHxS protein binding	No Results do not change draft judgements or provide essential insight into the dosimetric extrapolation approach.
Pan et al. (2019)	Lit Update	Other	human bone mesenchymal stem cells (hBMSCs) were used to evaluate the effects of Cl-PFESA at non-cytotoxic concentrations on molecular regulation and cellular function of stem	

Reference	Source	Assessment Topic	Description or Results	EPA disposition on incorporation and characterization of impact
			cells compared to PFOS, perfluorohexane sulfonate (PFHxS) and perfluorooctanoic acid (PFOA).	
Hoover et al. (2019)	Lit Update	Other	Examination of the cytotoxicity of PFAS singly and in binary mixtures using an amphibian fibroblast cell line. Second, we used this experimental data to develop quantitative structure-activity relationship (QSAR) models for single and binary mixtures.	
Xu et al. (2020b)	Lit Update	Other	Effects of PFAS exposure on serum microRNAs	
Modaresi et al. (2021)	Lit Update	Other	PFAS augment adipogenesis in 3T3-L1 adipocytes	
Mann et al. (2021)	Lit Update	Other	Use of human fatty acid binding protein to detect PFAS.	
Wang et al. (2018)	Lit Update	Other	Stabilization of liposomes by PFAS	
Nguyen et al. (2020)	Lit Update	Other	Inhibition of carbonic anhydrases by PFAS	
Liu et al. (2020c)	Lit Update	Other	PFAS effects on pancreatic and endocrine pluripotent cell differentiation	

Reference	Source	Assessment Topic	Description or Results	EPA disposition on incorporation and characterization of impact
Xie et al. (2021)	Lit Update	Other	PFAS and POPs effects on 3T3-L1 adipogenesis	
Shen et al. (2020)	Lit Update	Other	PFAS effects on lipid bilayer	
U.S. EPA (2019)	Lit Update	Other	CompTox Dashboard	

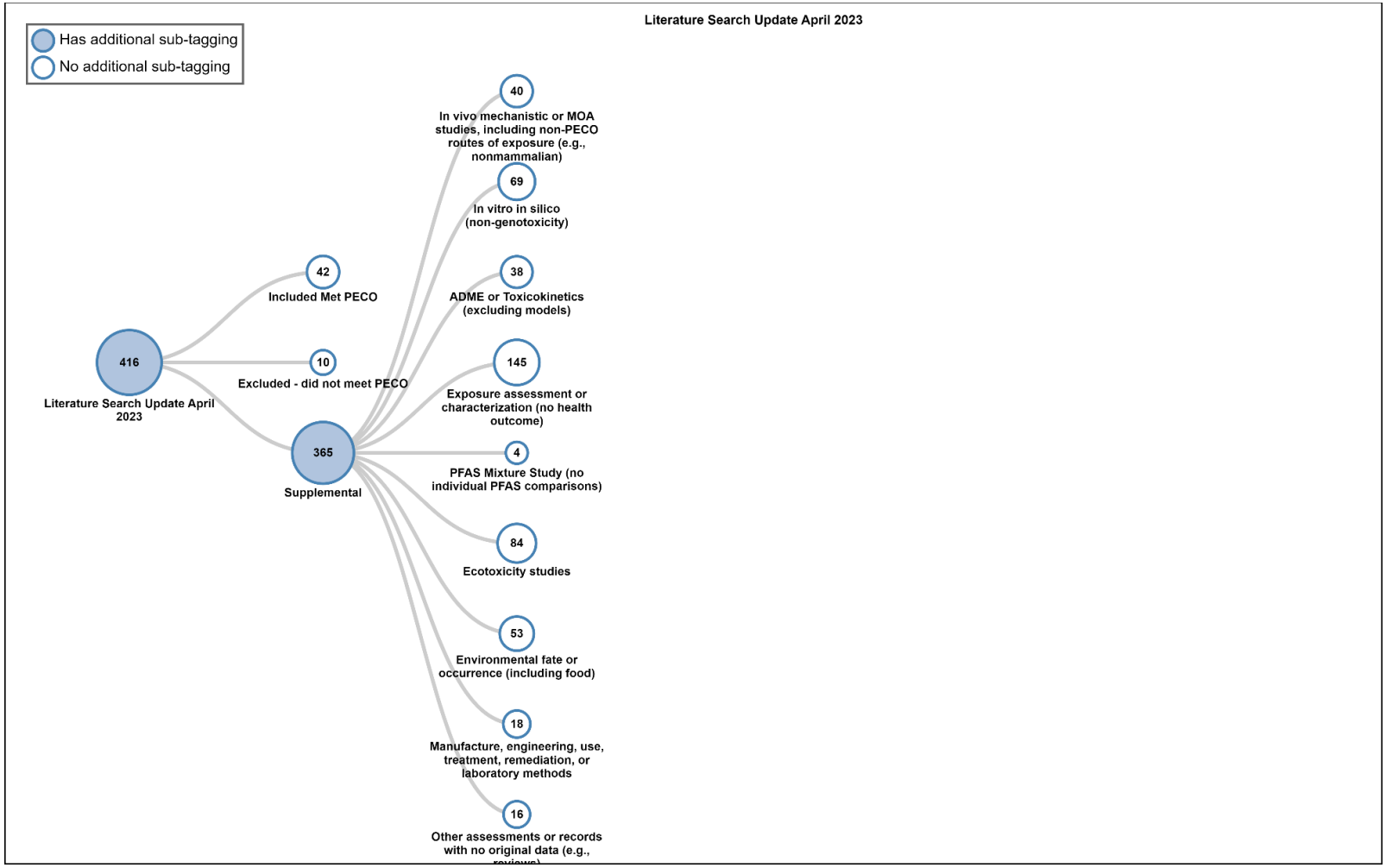

Figure 1. PFHxS new studies identified in the April 2023 literature search update or submitted to EPA during public comment. Diagram shows screening results for all identified studies. Information on EPA's disposition on the inclusion of these studies. Information on EPA's disposition on the inclusion of these studies prior to finalizing the assessment and characterization of their impact on key assessment decisions is provided in Table 1 and Table 2 for studies meeting PECO and for supplemental studies on ADME, mechanistic, and non-PECO exposure routes. Refer to interactive HAWC visual for additional information.

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