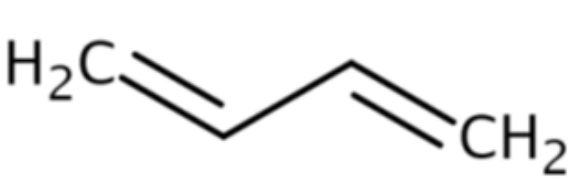
United States
Environmental Protection Agency

November 2024
Office of Chemical Safety and
Pollution Prevention

Further Filtering Results for Human Health Hazard Animal Toxicology and Epidemiology for 1,3-Butadiene

Systematic Review Support Document for the Draft Risk Evaluation

CASRN: 106-99-0



November 2024

This supplemental file contains information regarding the further filtering 'study-wide' extraction results for animal toxicology and epidemiology. Both animal toxicology and epidemiology filtered for studies with two or more exposure groups plus control or referent group. Additionally, key studies supporting dose-response analysis in existing authoritative reviews (*i.e.*, ATSDR or IRIS) were prioritized for data evaluation and extraction. Full details of the further filtering form and the filtering process are described in the *Draft Risk Evaluation for 1,3-Butadiene - Systematic Review Protocol*.

Table of Contents

Table of Contents

632551 Parent, M. E., Hua, Y., Siemiatycki, J. (2000). Occupational risk factors for renal cell carcinoma in Montreal. American Journal of Industrial Medicine 38(6):609-618. **26**

5660361 Pudrith, C., Dudley, W. N. (2019). Sensorineural hearing loss and volatile organic compound metabolites in urine. American Journal of Otolaryngology 40(3):409-412. **26**

10192219 Sathiakumar, N., Bolaji, B. E., Brill, I., Chen, L., Tipre, M., Leader, M., Arora, T., Delzell, E. (2021). 1,3-Butadiene, styrene and lymphohaematopoietic cancers among North American synthetic rubber polymer workers: exposure-response analyses. Occupational and Environmental Medicine 78(12):859-868. **27**

9038746 Sathiakumar, N., Bolaji, B., Brill, I., Chen, L., Tipre, M., Leader, M., Arora, T., Delzell, E. (2021). 1,3-Butadiene, styrene and selected outcomes among synthetic rubber polymer workers: Updated exposure-response analyses. Chemico-Biological Interactions 347:109600. **27**

1600222 Sathiakumar, N., Brill, I., Delzell, E. (2009). 1,3-butadiene, styrene and lung cancer among synthetic rubber industry workers. Journal of Occupational and Environmental Medicine 51(11):1326-1332. **28**

4659248 Sathiakumar, N., Brill, I., Leader, M., Delzell, E. (2015). 1,3-Butadiene, styrene and lymphohematopoietic cancer among male synthetic rubber industry workers–Preliminary exposure-response analyses. Chemico-Biological Interactions 241:40-49. **28**

1330953 Sathiakumar, N., Delzell, E. (2009). A follow-up study of mortality among women in the North American synthetic rubber industry. Journal of Occupational and Environmental Medicine 51(11):1314-1325. **29**

6592911 Sathiakumar, N., Tipre, M., Leader, M., Brill, I., Delzell, E. (2019). Mortality among men and women in the North American synthetic rubber industry, 1943 to 2009. Journal of Occupational and Environmental Medicine 61(11):887-897. **29**

6544022 Sielken, (2007). Quantitative risk assessment of exposures to butadiene in European Union occupational settings based on the University of Alabama at Birmingham epidemiology study: acute myelogenous leukemia, chronic lymphocytic leukemia, and chronic myelogenous leukemia. **30**

1798799 Sielken, R. L., Valdez-Flores, C. (2013). Quantitative risk assessment of exposures to butadiene in EU occupational settings based on the University of Alabama at Birmingham epidemiological study. Regulatory Toxicology and Pharmacology 65(2):214-225. **30**

1940484 Sielken, R. L., Valdez-Flores, C. (2011). Butadiene cancer exposure-response modeling: based on workers in the styrene-butadiene-rubber industry: total leukemia, acute myelogenous leukemia, chronic lymphocytic leukemia, and chronic myelogenous leukemia. Regulatory Toxicology and Pharmacology 60(3):332-341. **30**

1942871 Sielken, R. L., Valdez-Flores, C. (2001). Dose-response implications of the University of Alabama study of lymphohematopoietic cancer among workers exposed to 1,3-butadiene and styrene in the synthetic rubber industry. Chemico-Biological Interactions 135-136:637-651. **31**

2225126 Simpson, I. J., Marrero, J. E., Batterman, S., Meinardi, S., Barletta, B., Blake, D. R. (2013). Air quality in the Industrial Heartland of Alberta, Canada and potential impacts on human health. Atmospheric Environment 81:702-709. **31**

1357737 Sobel, W., Bond, G. G., Skowronski, B. J., Brownson, P. J., Cook, R. R. (1987). A soft tissue sarcoma case control study in a large multi-chemical manufacturing facility. Chemosphere 16(8-9):2095-2099. **31**

3358047 Symanski, E., Tee Lewis, P. G., Chen, T. Y., Chan, W., Lai, D., Ma, X. (2016). Air toxics and early childhood acute lymphocytic leukemia in Texas, a population based case control study. Environmental Health: A Global Access Science Source 15(1):70. **32**

2988431 Tsai, S. P., Ahmed, F. S., Ransdell, J. D., Wendt, J. K., Donnelly, R. P. (2005). A hematology surveillance study of petrochemical workers exposed to 1,3 butadiene. Journal of Occupational and Environmental Hygiene 2(10):508-515. **32**

2959630 Tsai, S. P., Wendt, J. K., Ransdell, J. D. (2001). A mortality, morbidity, and hematology study of petrochemical employees potentially exposed to 1,3-butadiene monomer. Chemico-Biological Interactions 135-136:555-567. **32**

5665016 UAB, (1995). Initial submission: Letter from intl inst syn rubber prod to USEPA RE prelim results in cohort mortality study of employees of 8 styrene butadiene rubber plants, dated 05/19/95. **33**

6544020 UAB, (2007). A follow-up study of women in the synthetic rubber industry. **33**

11531254 Valdez-Flores, C., Erraguntla, N., Budinsky, R., Cagen, S., Kirman, C. R. (2022). An updated lymphohematopoietic and bladder cancers risk evaluation for occupational and environmental exposures to 1,3-butadiene. Chemico-Biological Interactions 366:110077. **33**

2453135 von Ehrenstein, O. S., Aralis, H., Cockburn, M., Ritz, B. (2014). In utero exposure to toxic air pollutants and risk of childhood autism. Epidemiology 25(6):851-858. **34**

5684085 Von Ehrenstein, O. S., Heck, J. E., Park, A. S., Cockburn, M., Escobedo, L., Ritz, B. (2016). In utero and early-life exposure to ambient air toxics and childhood brain tumors: a population-based case-control study in California, USA. Environmental Health Perspectives 124(7):1093-1099. **34**

1268080 West, R. R., Stafford, D. A., Farrow, A., Jacobs, A. (1995). Occupational and environmental exposures and myelodysplasia: A case-control study. Leukemia Research 19(2):127-139. **34**

622776 Whitworth, K. W., Symanski, E., Coker, A. L. (2008). Childhood Lymphohematopoietic Cancer Incidence and Hazardous Air Pollutants in Southeast Texas, 1995–2004. Environmental Health Perspectives 116(11):1576-1580. **35**

1508766 Yuan, J. M., Gao, Y. T., Wang, R., Chen, M., Carmella, S. G., Hecht, S. S. (2012). Urinary levels of volatile organic carcinogen and toxicant biomarkers in relation to lung cancer development in smokers. Carcinogenesis 33(4):804-809. **35**

1,3-Butadiene- Parent compound						
Animal Species	Exposure Route and Exposure Duration	LOEL	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Mouse	Inhalation This is a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 500ppm (in air, water, or food) Positive for dominant lethal effect	Reproductive/Developmental, Other: Dominant lethality	This study does not report only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	Adler I-D et al. 1998 5663591 Reviewer: 1 and 2
Mouse	Inhalation This is not a reproductive/ developmental study. Chronic (>90 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 625ppm (in air, water, or food) Increased incidence of hemangiosarcomas, malignant lymphomas, alveolar-bronchiolar adenomas and carcinomas, forestomach squamous cell papillomas and squamous cell carcinomas, mammary carcinomas (female), and ovarian tumors. Additionally, testicular atrophy, ovarian atrophy, and uterine involution.	Neurological/Behavioral, Cancer/Carcinogenesis, Cardiovascular, Thyroid, Reproductive/Developmental, Gastrointestinal, Immune/Hematological, Hepatic/Liver, Mortality, Musculoskeletal, Nutritional/Metabolic, Ocular/Sensory, Renal/Kidney, Lung/Respiratory	This study does not report only negative outcomes.	Yes	Battelle PNL, 1982 5554646 Reviewer: 1
Mouse	Inhalation This is not a reproductive/ developmental study. Chronic (>90 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 625ppm (in air, water, or food) Increased incidence of hemangiosarcomas, malignant lymphomas, alveolar-bronchiolar adenomas and carcinomas, forestomach squamous cell papillomas and squamous cell carcinomas, mammary carcinomas (female), and ovarian tumors. Additionally, testicular atrophy, ovarian atrophy, and uterine involution.	Neurological/Behavioral, Cancer/Carcinogenesis, Cardiovascular, Thyroid, Reproductive/Developmental, Gastrointestinal, Immune/Hematological, Hepatic/Liver, Mortality, Musculoskeletal, Nutritional/Metabolic, Ocular/Sensory, Renal/Kidney, Lung/Respiratory, Other: clinical signs	This study does not report only negative outcomes.	Yes	Battelle PNL, 1982 5554646 Reviewer: 2
Mouse	Inhalation This is a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 40ppm (in air, water, or food) Developmental: Decreased male fetal body weight; Maternal tox at 200 ppm	Reproductive/Developmental, Mortality, Nutritional/Metabolic, Other: Clinical signs	This study does not report only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	Battelle PNL, 1987 62351 Reviewer: 1

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Animal Species	Exposure Route and Exposure Duration	LOEL	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Mouse	Inhalation This is a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 40ppm (in air, water, or food) Developmental: Decreased male fetal body weight; Maternal tox at 200 ppm	Reproductive/Developmental, Mortality, Nutritional/Metabolic, Other: Clinical signs	This study does not report only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk), Other: Fetal Sex Differences	Yes	Battelle PNL, 1987 62351 Reviewer: 2
Mouse	Inhalation This is a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 65ppm (in air, water, or food) Positive for dominant lethality	Reproductive/Developmental, Mortality, Nutritional/Metabolic, Other: Dominant lethality	This study does not report only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	BIBRA, 1996 5665017 Reviewer: 1 and 2
Rat	Inhalation This is a reproductive/ developmental study. Sub-Chronic (>30-90 days)	This experiment contains 2 or more dose groups in addition to a control.	Reproductive/Developmental, Mortality, Other: Dominant lethality	This study reports only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	BIBRA, 1996 5674659 Reviewer: 1
Rat	Inhalation This is a reproductive/ developmental study. Sub-Chronic (>30-90 days)	This experiment contains 2 or more dose groups in addition to a control.	Reproductive/Developmental, Mortality, Nutritional/Metabolic, Other: Dominant lethality	This study reports only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	BIBRA, 1996 5674659 Reviewer: 2
Rat	Inhalation This is not a reproductive/ developmental study. Acute (less than or equal to 24 hr)	This experiment does not contain 2 or more dose groups in addition to a control.	Mortality, Nutritional/Metabolic, Lung/Respiratory, Other: Clincal signs	This study reports only negative outcomes.	Not at this time	Bio/dynamics, 1980 11273558 Reviewer: 1 and 2
Mouse	Inhalation This is not a reproductive/ developmental study. Acute (less than or equal to 24 hr)	This experiment contains 2 or more dose groups in addition to a control.	Cancer/Carcinogenesis	This study reports only negative outcomes.	Yes	Bucher et al. 1993 5640580 Reviewer: 1
Mouse	Inhalation This is not a reproductive/ developmental study. Acute (less than or equal to 24 hr)	This experiment contains 2 or more dose groups in addition to a control.	Cancer/Carcinogenesis, Nutritional/Metabolic	This study reports only negative outcomes. Occupational and Consumer Exposures (ex. byproduct of work)	Yes	Bucher et al. 1993 5640580 Reviewer: 2

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Animal Species	Exposure Route and Exposure Duration	LOEL	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Rat	Inhalation This is not a reproductive/ developmental study. Chronic (>90 days)	This experiment contains 2 or more dose groups in addition to a control.	Neurological/Behavioral, Cancer/Carcinogenesis, Thyroid, Reproductive/Developmental, Gastrointestinal, Immune/Hematological, Hepatic/Liver, Musculoskeletal, Nutritional/Metabolic, Renal/Kidney, Lung/Respiratory, Skin/Connective Tissue, Other: Endocrine	This study reports only negative outcomes.	Yes	Crouch et al. 1979 94760 Reviewer: 1 and 2
Rat	Inhalation This is not a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment does not contain 2 or more dose groups in addition to a control.	Nutritional/Metabolic	This study reports only negative outcomes.	Not at this time	Elovaara et al. 1994 62726 Reviewer: 1
Rat	Inhalation This is not a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment does not contain 2 or more dose groups in addition to a control. LOEL: 500ppm (in air, water, or food) increase in metabolic enzyme activity in lung and liver shown in Table 1 within Water subgroup	Hepatic/Liver, Nutritional/Metabolic, Lung/Respiratory	This study does not report only negative outcomes. Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Not at this time	Elovaara et al. 1994 62726 Reviewer: 2
Rat	Inhalation This is not a reproductive/ developmental study. Chronic (>90 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 1000ppm (in air, water, or food) Carcinogenicity (increased tumor incidence at several sites, including mammary, thyroid, and uterus/vaginal in females; Leydig cells and pancreas in males; Zymbal gland in both sexes)	Neurological/Behavioral, Cancer/Carcinogenesis, Cardiovascular, Thyroid, Reproductive/Developmental, Gastrointestinal, Immune/Hematological, Hepatic/Liver, Mortality, Musculoskeletal, Nutritional/Metabolic, Ocular/Sensory, Renal/Kidney, Lung/Respiratory, Skin/Connective Tissue, Other: Endocrine organs, Serum chemistry	This study does not report only negative outcomes. Other: Sex	Yes	Hazleton Laboratories, 1981 5673742 Reviewer: 1

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Animal Species	Exposure Route and Exposure Duration	LOEL	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Rat	Inhalation This is not a reproductive/ developmental study. Chronic (>90 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 1000ppm (in air, water, or food) Carcinogenicity (increased tumor incidence at several sites, including mammary, thyroid, and uterus/vaginal in females; Leydig cells and pancreas in males; Zymbal gland in both sexes)	Neurological/Behavioral, Cancer/Carcinogenesis, Cardiovascular, Thyroid, Reproductive/Developmental, Gastrointestinal, Immune/Hematological, Hepatic/Liver, Mortality, Musculoskeletal, Nutritional/Metabolic, Ocular/Sensory, Renal/Kidney, Lung/Respiratory, Skin/Connective Tissue, Other: Endocrine organs, Serum chemistry	This study does not report only negative outcomes. Other: Sex	Yes	Hazleton Laboratories, 1981 5673742 Reviewer: 2
Rat	Inhalation This is a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 200ppm (in air, water, or food) Foetal defects, delayed growth	Reproductive/Developmental, Nutritional/Metabolic	This study does not report only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	Hazleton Labs, 1981 62371 Reviewer: 1
Rat	Inhalation This is a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 200ppm (in air, water, or food) Foetal defects, delayed growth	Reproductive/Developmental	This study does not report only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	Hazleton Labs, 1981 62371 Reviewer: 2
Mouse	Inhalation This is not a reproductive/ developmental study. Sub-Chronic (>30-90 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 2445.4ppm (in air, water, or food) Decreased body weight in males	Neurological/Behavioral, Gastrointestinal, Immune/Hematological, Hepatic/Liver, Mortality, Nutritional/Metabolic, Renal/Kidney, Lung/Respiratory, Skin/Connective Tissue, Other: Clinical signs, Endocrine	This study does not report only negative outcomes. Sociodemographic Status (ex. home near exposure source)	Yes	IBT Labs, 1977 11273565 Reviewer: 1

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Animal Species	Exposure Route and Exposure Duration	LOEL	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Mouse	Inhalation This is not a reproductive/ developmental study. Sub-Chronic (>30-90 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 2445.4ppm (in air, water, or food) Decreased body weight in males	Neurological/Behavioral, Gastrointestinal, Immune/Hematological, Hepatic/Liver, Mortality, Nutritional/Metabolic, Renal/Kidney, Lung/Respiratory, Skin/Connective Tissue, Other: Clinical signs, Endocrine	This study does not report only negative outcomes. Other: sex	Yes	IBT Labs, 1977 11273565 Reviewer: 2
Mouse	Inhalation This is not a reproductive/ developmental study. Chronic (>90 days)	This experiment does not contain 2 or more dose groups in addition to a control. LOEL: 1250ppm (in air, water, or food) Increased leukemia	Cancer/Carcinogenesis	This study does not report only negative outcomes. Genetics/Epigenetics (ex. genetic variants that increase susceptibility; knockout animals)	Not at this time	Irons et al. 1989 646911 Reviewer: 1 and 2
Mouse	Inhalation This is not a reproductive/ developmental study. Sub-Chronic (>30-90 days)	This experiment does not contain 2 or more dose groups in addition to a control. LOEL: 1250ppm (in air, water, or food) Decreased erythrocytes, total hemoglbin, hematocrit and increased mean corupscular volume.	Immune/Hematological	This study does not report only negative outcomes. Genetics/Epigenetics (ex. genetic variants that increase susceptibility; knockout animals)	Not at this time	Irons et al. 1986 62357 Reviewer: 1
Mouse	Inhalation This is not a reproductive/ developmental study. Sub-Chronic (>30-90 days)	This experiment does not contain 2 or more dose groups in addition to a control. LOEL: 1250ppm (in air, water, or food) Decreased erythrocytes, total hemoglobin, hematocrit and increased mean corpuscular volume.	Immune/Hematological, Nutritional/Metabolic	This study does not report only negative outcomes. Genetics/Epigenetics (ex. genetic variants that increase susceptibility; knockout animals)	Not at this time	Irons et al. 1986 62357 Reviewer: 2
Mouse	Inhalation This is not a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 500ppm (in air, water, or food) Decreased body weight	Nutritional/Metabolic	This study does not report only negative outcomes.	Yes	Lee et al. 2005 1329207 Reviewer: 1 and 2
Rat	Inhalation This is not a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control.	Mortality, Nutritional/Metabolic, Other: Clinical signs	This study reports only negative outcomes.	Yes	LRRI, 2005 11273463 Reviewer: 1 and 2
Mouse	Inhalation This is not a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control.	Mortality, Nutritional/Metabolic, Other: Clinical signs	This study reports only negative outcomes.	Yes	LRRI, 2005 11273463 Reviewer: 1 and 2

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Animal Species	Exposure Route and Exposure Duration	LOEL	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Rabbit	Ocular/Eye This is not a reproductive/ developmental study. Acute (less than or equal to 24 hr)	This experiment does not contain 2 or more dose groups in addition to a control.	Irritation	This study reports only negative outcomes.	Not at this time	Mobil Environmental and Health Science Laboratory, 1985 11273559 Reviewer: 1 and 2
Rabbit	Dermal This is not a reproductive/ developmental study. Acute (less than or equal to 24 hr)	This experiment does not contain 2 or more dose groups in addition to a control.	Irritation	This study reports only negative outcomes.	Not at this time	Mobil Environmental and Health Science Laboratory, 1985 11273559 Reviewer: 1 and 2
Mouse	Inhalation This is not a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 5000ppm (in air, water, or food) Body weight lost	Mortality, Nutritional/Metabolic	This study does not report only negative outcomes.	Yes	National Institutes of Health,, Department of Health and Human Services, 1984 62372 Reviewer: 1 and 2
Mouse	Inhalation This is not a reproductive/ developmental study. Sub-Chronic (>30-90 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 2500ppm (in air, water, or food) Body weight gain decreased	Mortality, Nutritional/Metabolic	This study does not report only negative outcomes.	Yes	National Institutes of Health,, Department of Health and Human Services, 1984 62372 Reviewer: 1 and 2

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Animal Species	Exposure Route and Exposure Duration	LOEL	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Mouse	Inhalation This is not a reproductive/ developmental study. Chronic (>90 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 625ppm (in air, water, or food) Neoplasm-heart, lung, forestomach, liver, ovary, testicular and brain	Cancer/Carcinogenesis, Mortality, Nutritional/Metabolic	This study does not report only negative outcomes.	Yes	National Institutes of Health,, Department of Health and Human Services, 1984 62372 Reviewer: 1 and 2
Rooster	Inhalation This is not a reproductive/ developmental study. Chronic (>90 days)	This experiment does not contain 2 or more dose groups in addition to a control. LOEL: 20ppm (in air, water, or food) Increased incidence of artherosclerotic plaques	Cardiovascular	This study does not report only negative outcomes. Lifestyle Activities (ex. exercise, smoking), Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Not at this time	Penn et al. 1996 5663744 Reviewer: 1 and 2
Rat	Inhalation This is a reproductive/ developmental study. Sub-Chronic (>30-90 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 1507ppm (in air, water, or food) Decreased body weight in F0 and F1 corresponding to reduced food consumption males and females	Neurological/Behavioral, Reproductive/Developmental, Hepatic/Liver, Mortality, Nutritional/Metabolic, Renal/Kidney, Lung/Respiratory, Other: Clinical signs, Endocrine	This study does not report only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	WIL Research, 2003 10367501 Reviewer: 1
Rat	Inhalation This is a reproductive/ developmental study. Sub-Chronic (>30-90 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 1507ppm (in air, water, or food) Decreased body weight in F0 and F1 males and females	Neurological/Behavioral, Reproductive/Developmental, Mortality, Renal/Kidney, Lung/Respiratory, Other: Clinical signs, Endocrine	This study does not report only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	WIL Research, 2003 10367501 Reviewer: 2
Mouse	Inhalation This is a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 500ppm (in air, water, or food) Decreased testis weight beginning 11 days after exposure	Reproductive/Developmental, Nutritional/Metabolic	This study does not report only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	Xiao et al. 1995 5546732 Reviewer: 1
Mouse	Inhalation This is a reproductive/ developmental study. Short-Term (>1-30 days)	This experiment contains 2 or more dose groups in addition to a control. LOEL: 500ppm (in air, water, or food) Decreased testis weight beginning 11 days after exposure	Reproductive/Developmental, Nutritional/Metabolic, Other: genotoxicity in spermatids	This study does not report only negative outcomes. Lifestage (ex. reproductive studies, accumulation in milk)	Yes	Xiao et al. 1995 5546732 Reviewer: 2

* Data Quality Evaluation and Extraction

1,3-Butadiene- Parent compound					
Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose Reported Exposure Levels: Other The study does not assess the association between exposure to the chemical of interest and a health outcome for other reason. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological	Geography/site-specific (ex. downstream of release sites)	No	Barregard et al. 2009 5621149
Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar, Biomarker of exposure with quantitative data Reported Exposure Levels: Other The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This study contains limited useful dose-response data as the exposure to 1,3-BTD through a cumulative exposure rank month along with other exposure substances modeled (styrene, acrylonitrile). This is an observational epidemiology study	Non-Cancer: Hepatic/liver	Occupational, Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	No	Cave et al. 2011 1008952
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This study contains useful dose-response data with lagged exposure reported. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Lifestage: Older adults (>=65 years) Occupational	Yes	Cheng et al. 2007 646899

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation, Dermal/Skin, Ocular/Eye Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): None - no quantitative measurement Quantitative method(s): Reported Exposure Levels: The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. No This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological	Occupational	No	Cole et al. 1993 51368
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Modeled concentration or dose Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome, A continuous measure of exposure but didn’t use this measurement in any model or analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Childhood cancer (before birth through age 18)	Lifestage: Infants (birth through <12 months), Children (age 1 year through <11 years)	Yes	Danysh et al. 2015 3011004
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Acute inhalation (24 hours or less), Short-term inhalation (>24 hours and <=28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. Table 4 contains potentially useful dose-response data This is an observational epidemiology study	Non-Cancer: Lung/respiratory	Lifestage: Children (age 1 year through <11 years), Adolescents (age 11 years through <21 years) Pre-existing Disease (ex. altered metabolism, behaviors, treatments related to condition), Geography/site-specific (ex. downstream of release sites), Sociodemographic status (ex. home near exposure source), Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Delfino et al. 2003 50460

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Dermal/Skin, Other Dermal/Skin (wipe sampling, questionnaire assessing dermal exposure, patch testing (intentional dosing), dermal chamber studies, shower studies, skin permeability coefficient, skin exposure biomarkers, etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose, Modeled concentration or dose, Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. "Both BD ppm-years and STY ppm-years displayed a consistent dose–response pattern in single exposure models, but for each chemical this pattern was weakened in analyses that controlled for the other agent. Further adjustment for DMDTC did not substantially alter the data for BD (also adjusted for STY), but did have a marked impact on the RRs for STY (also adjusted for BD), changing its association with leukemia from positive to inverse, without dose–response." This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Occupational, Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Delzell et al. 2001 737524
Inhalation, Dermal/Skin, Ocular/Eye, Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure Quantitative method(s): Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Cancer of the Reproductive System, Gastrointestinal, Immune/hematological, Hepatic/liver, Mortality, Nutritional/metabolic, Renal/kidney, Lung/respiratory Non-Cancer: Neurological/behavioral, Cardiovascular, Thyroid, Reproductive/developmental, Gastrointestinal, Immune/hematological, Mortality, Nutritional/metabolic, Renal/kidney, Lung/respiratory, Other	Lifestage: Older adults (>=65 years) Occupational	Yes	Delzell et al. 2006 737525
Inhalation, Dermal/Skin, Ocular/Eye Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure Quantitative method(s): Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Cancer of the Reproductive System, Gastrointestinal, Immune/hematological, Hepatic/liver, Mortality, Musculoskeletal, Renal/kidney, Lung/respiratory, Skin & connective tissue Non-Cancer: Neurological/behavioral, Cardiovascular, Reproductive/developmental, Gastrointestinal, Immune/hematological, Mortality, Nutritional/metabolic, Renal/kidney, Lung/respiratory, Other	Occupational	Yes	Delzell et al. 51390

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): None - no quantitative measurement Quantitative method(s): Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. "The lack of a dose–response effect was confirmed when the cumulative exposure score, i.e. the estimate that includes exposure class, the length of time in the job, and calendar time of exposure, was used in the Cox regression analysis. No association was found between the estimate of BD exposure and any LHC category. Again, these results are consistent with those for the varied exposure group in that the risk does not increase with increasing duration of exposure. These results from the Cox regression analysis are presumed to use a more accurate representation of the overall dose received by the cohort, and this method avoids the problems associated with using an external comparison group." This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Cancer of the Reproductive System, Gastrointestinal, Immune/hematological, Mortality, Renal/kidney, Lung/respiratory, Skin & connective tissue, Other: "All cancers" Non-Cancer: Cardiovascular, Hepatic/liver, Mortality, Nutritional/metabolic, Lung/respiratory, Other: "All external causes"	Occupational	No	Divine et al. 2001 2959633
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Lifestage: Older adults (>=65 years) Occupational	Yes	Graff et al. 2009 2950774

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.), Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Occupational, Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Graff et al. 2005 737523
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. Reported useful dose-response data in Table 2 and 3. This is an observational epidemiology study	Cancer/ Carcinogenesis: Cancer of the Reproductive System, Childhood cancer (before birth through age 18)	Lifestage: Pregnant people (parent) or embryo/fetus (developmental) (conception through birth), Children (age 1 year through <11 years) Studies focusing on reproductive parameters, Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Hall et al. 2019 5641117
Inhalation, Dermal/Skin, Ocular/Eye Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure Quantitative method(s): Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Other: Breast cancer	Occupational	No	Hansen, J. 2000 94367

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation, Dermal/Skin, Ocular/Eye Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.), Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Concentration or dose per time period (ex: mg/day, mg/kg/day, ml/hour, ml/year, TWA, etc.), Biomarker of exposure with quantitative data Reported Exposure Levels: Other The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. Analysis between exposed vs unexposed. No useful dose-response data. This is an observational epidemiology study	Cancer/ Carcinogenesis: Other: Genotoxicity Non-Cancer: Immune/hematological	Occupational, Genetics/Epigenetics (ex. genetic variants that icnrease susceptbility, knockout	No	Hayes et al. 2001 5552863
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.), Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) Acute inhalation (24 hours or less) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar, Concentration or dose per time period (ex: mg/day, mg/kg/day, ml/hour, ml/year, TWA, etc.), Biomarker of exposure with quantitative data Reported Exposure Levels: A continuous measure of exposure but didn’t use this measurement in any model or analyses of the association between the chemical of interest and a health outcome, An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. the only dose-response data is a correlation table, most analyses are just exposed vs unexposed This is an observational epidemiology study	Non-Cancer: Immune/hematological	Occupational, Genetics/Epigenetics (ex. genetic variants that icnrease susceptbility, knockout	Yes	Hayes et al. 2000 5586518

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose, Modeled concentration or dose Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Cancer of the Reproductive System	Lifestage: Older adults (>=65 years) Studies focusing on reproductive parameters, Lifestyle Activities (ex. exercise, smoking), Geography/site-specific (ex. downstream of release sites), Sociodemographic status (ex. home near exposure source), Aggregate Exposures (ex. multiple air exposure sources), Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Heck et al. 2024 11438289
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose, Modeled concentration or dose, Concentration or dose per time period (ex: mg/day, mg/kg/day, ml/hour, ml/year, TWA, etc.) Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Childhood cancer (before birth through age 18), Immune/hematological	Lifestage: Pregnant people (parent) or embryo/fetus (developmental) (conception through birth), Infants (birth through <12 months), Children (age 1 year through <11 years) Sociodemographic status (ex. home near exposure source), Aggregate Exposures (ex. multiple air exposure sources), Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Heck et al. 2014 2345720
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Childhood cancer (before birth through age 18), Ocular/sensory	Lifestage: Pregnant people (parent) or embryo/fetus (developmental) (conception through birth), Infants (birth through <12 months), Children (age 1 year through <11 years) Aggregate Exposures (ex. multiple air exposure sources)	Yes	Heck et al. 2013 2369182

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): None - no quantitative measurement Quantitative method(s): Reported Exposure Levels: Other The study does not assess the association between exposure to the chemical of interest and a health outcome for other reason. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. Contains no dose-response data. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Thyroid, Cancer of the Reproductive System, Gastrointestinal, Immune/hematological, Hepatic/liver, Mortality, Ocular/sensory, Renal/kidney, Lung/respiratory, Skin & connective tissue Non-Cancer: Neurological/behavioral, Cardiovascular, Gastrointestinal, Immune/hematological, Hepatic/liver, Mortality, Lung/respiratory	Occupational	No	IISRP, 1982 5372807
Inhalation, Dermal/Skin Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Modeled concentration or dose, Job-Exposure Matrix (JEM) or similar, Concentration or dose per time period (ex: mg/day, mg/kg/day, ml/hour, ml/year, TWA, etc.) Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. Information on multiple models' leukemia relative rate is provided by 1,3-BTD ppm- person years ranges (20, 0-38.7, 38.7-123.6, 123.6-287.3,287.3-641.9, 641.9+) additional associations and adjustments are shown. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Occupational	Yes	IISRP, 2000 5664525
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): None - no quantitative measurement Quantitative method(s): Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome, An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Thyroid, Cancer of the Reproductive System, Gastrointestinal, Immune/hematological, Hepatic/liver, Mortality, Musculoskeletal, Nutritional/metabolic, Ocular/sensory, Renal/kidney, Lung/respiratory, Skin & connective tissue	Occupational	No	IISRP, 1986 5672830

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Biomarker of exposure with only binary data (detected/undetected) Quantitative method(s): Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological	Occupational	No	Johns Hopkins University, 1988 5665273
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure Quantitative method(s): Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological	Occupational	No	Johns Hopkins University, 1988 5673747
Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure Quantitative method(s): Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Cardiovascular, Thyroid, Cancer of the Reproductive System, Gastrointestinal, Immune/hematological, Hepatic/liver, Mortality, Musculoskeletal, Nutritional/metabolic, Ocular/sensory, Renal/kidney, Lung/respiratory, Skin & connective tissue, Other: ”all cancers” Non-Cancer: Neurological/behavioral, Cardiovascular, Reproductive/developmental, Gastrointestinal, Immune/hematological, Hepatic/liver, Mortality, Nutritional/metabolic, Renal/kidney, Lung/respiratory, Irritation, Sensitization, Other: ”All external causes, all accidents, motor vehicle accidents, suicides”	Occupational, Sociodemographic status (ex. home near exposure source)	No	Johns Hopkins University, 1992 5790933

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study does not assess occupational exposure.	Quantitative measurement type(s): None - no quantitative measurement Quantitative method(s): Reported Exposure Levels: Other: classified by levels of outcome instead of exposure The study does not assess the association between exposure to the chemical of interest and a health outcome for other reason. No analysis based on measured exposure levels; patients are classified by severity of symptoms and the only analysis compares clinical parameters across different levels of symptomatic severity.The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. No, no real exposure vs. outcome statistical analysis This is an observational epidemiology study	Non-Cancer: Neurological/behavioral	Geography/site-specific (ex. downstream of release sites)	No	Khalil et al. 2007 5617530
Inhalation, Other Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): None - no quantitative measurement Quantitative method(s): Reported Exposure Levels: Other The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This study explores a boundary crossing technique as being ”useful for examining simultaneous exposures to several hazard types”, however, no quantitative dose data was available in the study. Distance from bus stations, railway stations, railways, roads, canals, estuaries, and other rivers were the main measurement of exposure, 1,3-BTD is mentioned as a prominent carcinogen found at these sites but no quantitative measures on exposure levels are taken. ”Stimulated proliferation of an existing malignant clone by a viral or other infection offers a reasonable pathogenetic model for a tumour of the immune system; and this could explain the many reported occurrences of close-set space-time onset clusters.” This is an observational epidemiology study	Cancer/ Carcinogenesis: Childhood cancer (before birth through age 18), Immune/hematological, Mortality, Other: ”other ‘solid’ tumours” Non-Cancer: Mortality	Lifestage: Pregnant people (parent) or embryo/fetus (developmental) (conception through birth), Infants (birth through <12 months), Children (age 1 year through <11 years), Adolescents (age 11 years through <21 years) Geography/site-specific (ex. downstream of release sites), Sociodemographic status (ex. home near exposure source), Aggregate Exposures (ex. multiple air exposure sources), Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	No	Knox, E. G. 2006 1938083

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study does not assess occupational exposure.	Quantitative measurement type(s): None - no quantitative measurement Quantitative method(s): Reported Exposure Levels: Other The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. Exposure levels were based on distance to nearest emission hotspot. This is an observational epidemiology study	Cancer/ Carcinogenesis: Childhood cancer (before birth through age 18), Mortality	Lifestage: Infants (birth through <12 months), Children (age 1 year through <11 years) Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	No	Knox, E. G. 2005 88410
Inhalation, Dermal/Skin, Drinking water, Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Other (please specify), County-level annual toxic releases in pounds Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure, Other: ncludes a dichotomous variable (zero release; nonzero release) The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. Range of exposure to 1,3 BTD is not specified. This is an observational epidemiology study	Cancer/ Carcinogenesis: Lung/respiratory	Geography/site-specific (ex. downstream of release sites), Sociodemographic status (ex. home near exposure source)	Yes	Luo, et al. 2011 1021648
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose, Modeled concentration or dose Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Cancer of the Reproductive System	Lifestage: Older adults (>=65 years) Studies focusing on reproductive parameters, Geography/site-specific (ex. downstream of release sites), Aggregate Exposures (ex. multiple air exposure sources), Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Niehoff et al. 2019 5440630

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: A continuous measure of exposure but didn’t use this measurement in any model or analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Occupational	No	NIOSH, 1994 5790851
Inhalation, Dermal/Skin Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): None - no quantitative measurement Quantitative method(s): Reported Exposure Levels: Other The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. No useful dose-response data. This is an observational epidemiology study	Cancer/ Carcinogenesis: Renal/kidney	Occupational	No	Parent et al. 2000 632551
Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Biomarker of exposure with quantitative data Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Non-Cancer: Ocular/sensory	Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Pudrith et al. 2019 5660361

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose, Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome, An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Lifestage: Older adults (>=65 years) Occupational	Yes	Sathiakumar et al. 2021 10192219
Inhalation, Dermal/Skin Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose, Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome, An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Gastrointestinal, Mortality, Nutritional/metabolic, Renal/kidney, Lung/respiratory Non-Cancer: Lung/respiratory	Lifestage: Older adults (>=65 years) Occupational	Yes	Sathiakumar et al. 2021 9038746

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome, An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Mortality, Lung/respiratory	Lifestyle Activities (ex. exercise, smoking), Occupational, Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Sathiakumar et al. 2009 1600222
Inhalation, Dermal/Skin, Ocular/Eye Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome, An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Occupational	Yes	Sathiakumar et al. 2015 4659248

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation, Dermal/Skin, Ocular/Eye, Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. Useful for dose-response: exposure concentrations extrapolated from JEM, at least three levels of exposure. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Cancer of the Reproductive System, Gastrointestinal, Immune/hematological, Hepatic/liver, Mortality, Nutritional/metabolic, Renal/kidney, Lung/respiratory Non-Cancer: Neurological/behavioral, Cardiovascular, Thyroid, Reproductive/developmental, Gastrointestinal, Immune/hematological, Mortality, Nutritional/metabolic, Renal/kidney, Lung/respiratory, Other	Lifestage: Older adults (>=65 years) Studies focusing on reproductive parameters, Occupational, Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Sathiakumar et al. 2009 1330953
Inhalation, Dermal/Skin, Ocular/Eye, Other Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.), Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Cancer of the Reproductive System, Gastrointestinal, Immune/hematological, Hepatic/liver, Mortality, Renal/kidney, Lung/respiratory Non-Cancer: Neurological/behavioral, Cardiovascular, Thyroid, Reproductive/developmental, Gastrointestinal, Immune/hematological, Mortality, Nutritional/metabolic, Renal/kidney, Lung/respiratory	Lifestage: Older adults (>=65 years) Studies focusing on reproductive parameters, Occupational, Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Sathiakumar et al. 2019 6592911

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Modeled concentration or dose, Job-Exposure Matrix (JEM) or similar, Concentration or dose per time period (ex: mg/day, mg/kg/day, ml/hour, ml/year, TWA, etc.) Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Occupational	Yes	Sielken, 2007 6544022
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. The study contains useful dose-response data, 1,3-BTD cumulative inhalation exposure is reported in ppm-years and detailed analysis is performed, and exposure response modeling is broken down in detail. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Lifestage: Older adults (>=65 years) Occupational	Yes	Sielken et al. 2013 1798799
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Modeled concentration or dose, Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Occupational	Yes	Sielken et al. 2011 1940484

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose, Modeled concentration or dose Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality	Occupational, Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Sielken et al. 2001 1942871
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose Reported Exposure Levels: A continuous measure of exposure but didn’t use this measurement in any model or analyses of the association between the chemical of interest and a health outcome The study does not assess the association between exposure to the chemical of interest and a health outcome for other reason. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. the analysis only compares cancer incidence rates across counties, there's no direct statistical test of association between 1,3-BTD exposure and cancer incidence This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological	Lifestyle Activities (ex. exercise, smoking), Geography/site-specific (ex. downstream of release sites), Sociodemographic status (ex. home near exposure source), Nutrition (ex. contaminated food source), Genetics/Epigenetics (ex. genetic variants that icnrease susceptbility, knockout, Aggregate Exposures (ex. multiple air exposure sources)	No	Simpson et al. 2013 2225126
Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): None - no quantitative measurement Quantitative method(s): Reported Exposure Levels: The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Mortality, Skin & connective tissue	Occupational, Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	No	Sobel et al. 1987 1357737

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Modeled concentration or dose Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome, A continuous measure of exposure but didn’t use this measurement in any model or analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Childhood cancer (before birth through age 18), Immune/hematological	Lifestage: Pregnant people (parent) or embryo/fetus (developmental) (conception through birth), Infants (birth through <12 months), Children (age 1 year through <11 years) Lifestyle Activities (ex. exercise, smoking), Sociodemographic status (ex. home near exposure source), Aggregate Exposures (ex. multiple air exposure sources), Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Symanski et al. 2016 3358047
Inhalation, Dermal/Skin Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose, Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: A continuous measure of exposure but didn’t use this measurement in any model or analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. analysis is only exposed vs. unexposed; study published by company producing the chemical This is an observational epidemiology study	Non-Cancer: Immune/hematological	Occupational	No	Tsai et al. 2005 2988431
Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): None - no quantitative measurement Quantitative method(s): Reported Exposure Levels: Other The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality, Musculoskeletal, Other Non-Cancer: Neurological/behavioral, Cardiovascular, Reproductive/developmental, Gastrointestinal, Immune/hematological, Mortality, Musculoskeletal, Renal/kidney, Lung/respiratory, Skin & connective tissue	Occupational	No	Tsai et al. 2001 2959630

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar, Concentration or dose per time period (ex: mg/day, mg/kg/day, ml/hour, ml/year, TWA, etc.) Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Cancer of the Reproductive System, Gastrointestinal, Immune/hematological, Mortality, Renal/kidney, Lung/respiratory, Skin & connective tissue, Other: Benign neoplasms Non-Cancer: Neurological/behavioral, Cardiovascular, Gastrointestinal, Immune/hematological, Mortality, Nutritional/metabolic, Renal/kidney, Lung/respiratory	Occupational	Yes	UAB, 1995 5665016
Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Job-Exposure Matrix (JEM) or similar Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Cancer of the Reproductive System, Gastrointestinal, Immune/hematological, Hepatic/liver, Mortality, Nutritional/metabolic, Renal/kidney, Lung/respiratory, Other: "all cancer" Non-Cancer: Neurological/behavioral, Cardiovascular, Gastrointestinal, Immune/hematological, Mortality, Renal/kidney, Lung/respiratory, Other: Benign neoplasms, External causes, Other known, Unkown	Lifestyle Activities (ex. exercise, smoking), Occupational, Sociodemographic status (ex. home near exposure source), Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	UAB, 2007 6544020
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study assesses occupational exposure.	Quantitative measurement type(s): Biomarker of exposure with only binary data (detected/undetected), Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Concentration or dose per time period (ex: mg/day, mg/kg/day, ml/hour, ml/year, TWA, etc.) Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological, Mortality, Renal/kidney	Occupational	Yes	Valdez-Flores et al. 2022 11531254

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Measured concentration or dose Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Non-Cancer: Neurological/behavioral, Reproductive/developmental	Lifestage: Pregnant people (parent) or embryo/fetus (developmental) (conception through birth), Children (age 1 year through <11 years) Aggregate Exposures (ex. multiple air exposure sources)	Yes	von Ehrenstein et al. 2014 2453135
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Modeled concentration or dose Reported Exposure Levels: An exposure-response model using a continuous measure (or estimate) of exposure The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Neurological/behavioral, Childhood cancer (before birth through age 18)	Lifestage: Pregnant people (parent) or embryo/fetus (developmental) (conception through birth), Infants (birth through <12 months), Children (age 1 year through <11 years) Geography/site-specific (ex. downstream of release sites), Sociodemographic status (ex. home near exposure source), Aggregate Exposures (ex. multiple air exposure sources), Other Chemical and Non-chemical stressors (ex. exposure to other substances that affect same organ as test chemical)	Yes	Von Ehrenstein et al. 2016 5684085
Other Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) This study assesses occupational exposure.	Quantitative measurement type(s): Duration of exposure Quantitative method(s): Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study does not report a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological	Occupational, Sociodemographic status (ex. home near exposure source)	No	West et al. 1995 1268080

Continued on next page . . .

. . . continued from previous page

1,3-Butadiene- Parent compound

Exposure	Measured Exposure	Principal Target Organs/Systems	PESS	Move to DEvEx*	Citation, HERO ID, and Reviewer
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Modeled concentration or dose Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Immune/hematological	Lifestage: Children (age 1 year through <11 years), Adolescents (age 11 years through <21 years) Geography/site-specific (ex. downstream of release sites)	Yes	Whitworth et al. 2008 622776
Inhalation Inhalation (air sampling, personal air monitoring, area air monitoring, inhalation chamber studies, shower studies, questionnaire assessing inhalation exposure, lung tissue exposure biomarkers, etc.), Other (duration, non-route-specific biomarker (matrices such as blood, urine, etc.) etc.) Chronic inhalation (more than 28 days) This study does not assess occupational exposure.	Quantitative measurement type(s): Duration of exposure, Quantitative measurement or estimate of concentration or dose of the chemical of interest Quantitative method(s): Biomarker of exposure with quantitative data Reported Exposure Levels: Three or more levels of exposure (i.e., referent group + 2 or more groups), which were used in the analyses of the association between the chemical of interest and a health outcome, A continuous measure of exposure but didn’t use this measurement in any model or analyses of the association between the chemical of interest and a health outcome The study assesses the association between exposure to the chemical of interest and a health outcome. The study reports a quantitative measurement or estimate of concentration or dose of the chemical of interest. This is an observational epidemiology study	Cancer/ Carcinogenesis: Lung/respiratory	Lifestyle Activities (ex. exercise, smoking)	Yes	Yuan et al. 2012 1508766

* Data Quality Evaluation and Extraction