



CHEMICAL CONTAMINANTS AND HUMAN DISEASE: A SUMMARY OF EVIDENCE

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Supported by the Collaborative on Health and the Environment
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For questions or comments about the database, please contact Eleni Sotos at Eleni@HealthandEnvironment.org.

Please note that the attached document is a spreadsheet version of the CHE Toxicant and Disease Database. The spreadsheet was created to provide a hard copy version to those without computers or Internet access and to distribute to relevant conference and meetings. The online version of the database, located at <http://database.healthandenvironment.org>, offers the user the opportunity to search the database by toxicant, disease, disease category or Chemical Abstract Service (CAS) number. To request additional hard copies of the spreadsheet or an electronic Excel file via email, contact Eleni Sotos, National Coordinator of the Collaborative on Health and the Environment at Eleni@HealthandEnvironment.org.

About the CHE Toxicant and Disease Database (Spreadsheet Version)

Human disease results from complex interactions among genes and the environment. Environmental exposures to chemical, physical, and biological agents may cause or contribute to disease in susceptible individuals. Personal lifestyle factors, such as diet, smoking, alcohol use, level of exercise, and UV exposure, often are a primary focus when considering preventable causes of disease. However, exposures to chemical contaminants on the job, at home, in the outdoors, and even in utero, are increasingly recognized as important and preventable contributors to human disease. These exposures are the focus of this project.

More than 80,000 chemicals have been developed, distributed, and discarded into the environment over the past 50 years. The majority of them have not been tested for potential toxic effects in humans or animals. Some of these chemicals are commonly found in air, water, food, homes, work places, and communities. Whereas the toxicity of one chemical may be incompletely understood, an understanding of the effect from exposures to mixtures of chemicals is even less complete. Chemicals may have opposing, additive, or even synergistic effects. One example of a synergistic effect is tobacco smoking coupled with asbestos exposure, which increases the risk of lung cancer by 25-fold—a risk much higher than that resulting from the sum of the risks of the individual agents.

Toxic effects of chemical agents are often not well understood or appreciated by health care providers and the general public. Some chemicals, such as asbestos, vinyl chloride and lead, are well established as causes of human disease. There also is good evidence to suggest increases in the incidence of some cancers, asthma, and developmental disorders can be attributed to chemical exposure,

particularly in young children. Other diseases, such as ALS or Gulf War Syndrome have been hypothesized to be associated with chemical exposures, but the evidence is limited.

The effects of chemical exposures in humans are difficult to study because controlled human experimentation isn't ethically feasible. There is limited human data obtained from accidental exposures, overdoses, or studies of workers exposed occupationally. Environmental exposure studies in the general population also can be useful, though they often have limitations. Many diseases, such as cancer, may not appear until decades after an exposure has occurred making it difficult for causal associations to be identified. Exposure assessment, a critical step in environmental epidemiologic studies, is difficult. Retrospective exposure assessment usually requires estimates and considerable judgment and is subject to significant error. An individual's exposure may change over time, and exposures occur to multiple chemicals both in the home and work environments. It is difficult for individuals to remember what they have been exposed to and, moreover, most people are unaware of what their exposures were.

The effects of chemical exposures may vary, depending on the age of exposure (in utero, childhood, adult), the route of exposure (ingestion, inhalation, dermal), amount and duration of exposure, exposures to multiple chemicals simultaneously, and other personal susceptibility factors, including genetic variability.

Because of these challenges, most toxicity research is conducted in animal studies. Although animal studies are not the emphasis of this database, animal studies contribute important toxicological information and can provide strong evidence of disease without human epidemiological studies if the mechanism of action is relevant. Many regulatory decisions to limit or ban a chemical's use are based on animal data. Furthermore, human epidemiology studies often are conducted after an association has been hypothesized based on animal data.

The accompanying database summarizes links between chemical contaminants and ~180 human diseases or conditions. We have designed this database to reflect the current state of knowledge about toxicants and human disease, organized by disease categories. Because the database focuses primarily on human epidemiological studies and a comprehensive review of animal data was beyond the scope of this project, animal data were included for only a few diseases.

Data for the database were obtained from three major textbooks on the topic of environmental medicine and toxicology. These sources are:

1. Klaassen CD, Ed. Casarett and Doull's Toxicology: The Basic Science of Poisons, 6th edition. (2001) McGraw-Hill publishing, New York.
2. LaDou J. Ed. Occupational and Environmental Medicine, 3rd edition (2004), Lange Medical/McGraw-Hill, New York.
3. Rom WM, Ed. Environmental and Occupational Medicine, 3rd edition (1998). Lippincott-Raven, Philadelphia, PA.

Literature searches for human epidemiological studies and reviews of disease topics were carried out to supplement and update textbook information.

Strength of evidence

Chemicals that have been linked to a condition are placed in one of three categories based on the strength of evidence for the association.

The "strong evidence" category is reserved for chemicals where a causal association with disease has been verified. The toxicity of these chemicals has been well-accepted by the medical community and is noted in the textbook references as, "It is well known that x chemical causes y condition" or "There is strong evidence that x compound causes y disease". Other chemicals were put into this category by causal associations drawn from more recent large prospective or retrospective cohort studies. Finally, chemicals listed as Group 1 human carcinogens by the International Agency for Research on Cancer (IARC) are included in this category. These are chemicals that have been determined to have sufficient evidence for causing cancer in humans.

The "good evidence" category includes chemicals associated with a disease through epidemiological studies (cross-sectional, case-series, or case-control studies) or for chemicals with some human evidence and strong corroborating animal evidence of an association. Textbook statements such as, "There is evidence for an association between exposure to x compound and y disease." assumed good evidence. IARC Group 2A chemicals, those with limited evidence for causing cancer in humans and sufficient evidence in animals, also are included in this category.

The "limited/conflicting evidence" category contains chemicals weakly associated with human disease by reports from only a few exposed individuals (case reports), from conflicting human epidemiological studies that have given mixed or equivocal results, or in a few cases, from reports clearly demonstrating toxicity in animals where no human data exist. Also included in this category are IARC Group 2B chemicals and EPA Group B2 chemicals. These chemicals show limited or inadequate evidence of causing cancer in humans and limited animal evidence of causing cancer.

The majority of the chemicals in the database fall into the "limited/conflicting" evidence category. This is because human epidemiological studies are very complex, difficult to design and interpret, and cannot be easily repeated. Health outcomes linked to exposures to mixtures of compounds, such as pesticides or solvents, sometimes provide hints of causal associations and direct future research efforts but usually cannot provide strong evidence, especially for one particular chemical. Animal data often provide the supporting evidence of an individual chemical's toxicity when human data are missing or incomplete.

As more scientific research is done some chemicals in the database may be found to have stronger evidence for causing disease, new chemicals will be added, and others may be found to have no association with a disease and fall off the list entirely.

Database limitations

This database has significant limitations that are important to keep in mind.

1. The chemicals listed are a representation of toxicants that contribute to human disease and disorders. This is not an exhaustive or comprehensive list and includes primarily chemicals and diseases found in major textbooks and medical literature reviews. Chemicals that are not listed also may be causally associated with a disease.

2. The database does not address the route, timing, duration, or amount of exposure required to result in a particular condition. Some chemicals may only be toxic if inhaled, whereas others need to be ingested in order to be toxic. Some diseases result from only high dose exposures whereas low-level exposures may be less important. Moreover, variations in the susceptibility to toxic effects, depending on the timing and duration of exposure, are not addressed. For example, a fetus or developing child is often more susceptible to a given exposure than an adult. For details on the dose, timing, duration, and route of exposure, etc. the reader is referred to the textbooks, references, and the attached web-links.

3. The database makes no attempt to quantify the proportion of disease that is caused or contributed to by specific environmental factors. For example, mesothelioma, a rare form of cancer, is almost entirely due to exposure to asbestos. In contrast, the proportion of lung cancer cases caused by asbestos exposure is relatively small compared to the number of cases caused by tobacco smoking or radon.

4. Finally, this is a work in progress. In many cases, the authors exercised judgment when considering the strength and categorization of evidence. Comments from readers are welcome and should be sent to Sarah Janssen at sarahjanssen@comcast.net or Eleni Sotos at Eleni@HealthandEnvironment.org.

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Toxicants - By Strength of Evidence

| DISEASE | CATEGORIES | STRONG | GOOD | LIMITED or CONFLICTING | REFERENCES | SIDENOTES IN SOME CHEMICALS AND DISEASES |
|--|--------------------------------------|--|---|---|--|--|
| Abnormal sperm (morphology, motility, and sperm count) | | 1 chlordecone; dibromochloropropane (DBCP); Ethylene glycol ethers; Heat; ethylene dibromide (EDB); Ionizing radiation; Microwave radiation; lead; 1,1-dichloroethane | 2-bromopropane; carbon disulfide; Estrogens/DES; PCBs; Pesticides; alachlor; atrazine; benomyl; 2,4-D; diazinon; gossypol; 1,1-dichloroethane; Tobacco Smoke (Active smoking) | toluene diamine; toluene; ozone; tetrachloroethylene (PCE); Furans; octylphenol; lindane; TNT (Trinitrotoluene); bisphenol A; acrylamide; aluminum; Alkyl phenols; 1,3-butadiene; boron; bromine ; cadmium; Chromium; Dinitrotoluenes; Dioxins/TCDD; ethyl alcohol (ethanol); ethylene oxide; Microwave radiation; Polybrominated Diphenyl Ethers (PBDEs); Pesticides; carbaryl; dinoseb; fenchlorphos; Organochlorine pesticides; DDT/DDE; mirex; molinate; Phthalates; Solvents; acetone; styrene | See references at end of document 42; 53; 56; 75; 76; 80; 89; 98; 134; 139; 145; 161; 165; 181; 202; 209; 217; 222; 223; 235; 240; 241; 251 | Maternal tobacco smoking has recently been correlated with decreased sperm density. |
| Acroosteolysis (vinyl chloride disease) | Dermatology (Skin); Immunology | vinyl chloride | | | | Affected workers polymerizing vinyl chloride in 1960's. Patients developed finger parathesias, cold sensitivity, Raynaud's phenomenon, pseudo-clubbing of the fingers, and skin edema and thickening of the fingers, hands, and forearms. Increased prevalence noted in HLA DR3 and DR3/B8 haplotypes. |
| Acute hepatocellular injury (Hepatitis) | Liver; Gastrointestinal | Anesthetic gases; halothane; Chlorinated naphthalenes; ethyl alcohol (ethanol); Ionizing radiation; phosphorus; Solvents; bromobenzene; carbon tetrachloride; carbon tetrabromide; chloroform; dimethylformamide; tetrachloroethane; trichloroethylene (TCE); TNT (Trinitrotoluene); Aflatoxins; Mushroom toxins | antimony; hexachlorobenzene; 2-nitropropane; paraquat; diquat; PCBs; phosphine; Dioxins/TCDD; trichloroethane | Chromic acid; dichloroacetylene; dichlorohydrin; dimethylacetamide; Manganese carbonyls; Pesticides; Organochlorine pesticides; chlordecone; 2,4-D; sulfuryl fluoride; styrene; toluene; xylene | 47; 144 | |
| Acute tubular necrosis | Renal (kidney) | Metals; arsine; cadmium; Chromium; lead; mercury; Stibene (antimony); vanadium; Solvents; carbon tetrachloride; chloroform; 1,1-dichloroethane; methanol; pentachlorophenol (PCP); phosphorus | dioxane; diquat; ethylene chlorohydrin; Ethylene glycols; Ethylene glycol ethers; Ionizing radiation; paraquat; Petrochemicals; Solvents; tetrachloroethane; trichloroethylene (TCE); toluene; uranium; vinylidene chloride | arsenic; bromobenzene; carbolic acid; copper; Dinitrophenols; Dinitro-o-Cresols; glycerol; Manganese carbonyls; Organophosphates; potassium bromate; Solvents; 1,2-dichloroethane; tetrachloroethylene (PCE); tetrafluoroethylene; sulfuryl fluoride | | Cigarette smokers have double the cadmium exposure of non-smokers resulting in 4-5 times higher blood cadmium levels and 2-3 times higher kidney cadmium levels. In nonsmokers, the main route of exposure to cadmium is through the diet. Inorganic mercury salts are most nephrotoxic. Methanol toxicity is due to the formation of formaldehyde and formate metabolic products. Pentachlorophenol (PCP) causes reversible decreased renal function at subtoxic doses. Arsine causes hemolysis and ATN secondary to hemoglobinuria. Toluene has been implicated as a nephrotoxin in inhalation abuse of solvents and glue. |
| ADD/ADHD, hyperactivity | Developmental; Neurology; Pediatrics | ethyl alcohol (ethanol); PCBs; lead | manganese; Solvents; Tobacco smoke (Secondhand) | cadmium; Polybrominated Diphenyl Ethers (PBDEs); Pesticides; DDT/DDE; Organophosphates; chlorpyrifos; diazinon; Pyrethins/Pyrethroids; bioallethrin; deltamethrin; cypermethrin; trichloroethylene (TCE); trimethyltin | 44; 58; 60; 105; 137; 181; 182 | |

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|--|--|---|--|--|--|--|
| Adrenal cancer | Oncology (cancer); Endocrine (Hormones) | | | acrylamide#; asulam; methyl isocyanate; pentachlorophenol (PCP); propylene oxide | | # - Group 2B human carcinogen (IARC) |
| Adult-onset Leukemias * | Hematology (Blood); Oncology (cancer) | benzene+; ethylene oxide+; Ionizing radiation+ | arsenic; Aromatic amines; 1,3- butadiene#; carbon disulfide; Dioxins/TCDD; formaldehyde; Chlorinated solvents; carbon tetrachloride; 1,2-dichloroethane^; Pesticides; Agent Orange; alachlor; DDT/DDE; Phenoxyacetic herbicides; Tobacco Smoke (Active smoking) | asbestos; Chromium; Electromagnetic fields; PAHs; Pesticides; atrazine; Carbamates; captan; Organochlorine pesticides; chlordane^; dieldrin; lindane^; Organophosphates; crotoxyphos; dichlorvos^; methidathion; Pyrethins/Pyrethroids; styrene^; tetrachloroethylene (PCE)^; trichloroethylene (TCE) | 27; 29; 81; 89; 90; 92; 98; 107; 108; 116; 123; 186; 187; 202 | * - general category including acute and chronic leukemia. + - Group 1 human carcinogen, # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC). In addition to the pesticides listed, unspecified pesticide exposure in applicators, manufacturers, and agricultural workers has been associated with leukemia. In these situations, the individual is exposed to mixtures of pesticides or different pesticides at different times. Associations between a specific pesticide exposure and disease can not be made. |
| Alopecia (hair loss) | Dermatology (Skin) | thallium | arsenic; boron; gold; 1,1- dichloroethane | selenium | 50 | |
| ALS (Lou Gehrig's disease) | Neurology | | | aluminum; Cycad nut; Ionizing radiation; lead; manganese; mercury; Pesticides; selenium; Solvents | 80; 167; 203 | |
| Altered sex ratio | Developmental; Genito-Urinary; Reproduction | | boron; dibromochloropropane (DBCP); Dioxins/TCDD; Fungicides; mercury | Organochlorine pesticides; PCBs | 44; 46; 56; 80; 123; 142; 143; 202; 243; 244 | In families where fungicides were applied by the father, significantly fewer male children were born (44) An increase in male fetal death has been observed due to methyl mercury in Minamata, Japan in the 1950s. |
| Altered time to sexual maturation (accelerated or delayed puberty) | Developmental; Endocrine (Hormones); Reproduction | Estrogens/DES | lead | bisphenol A; Dioxins/TCDD; Organochlorine pesticides; chlordecone; DDT/DDE; PBBs; PCBs; vinclozolin; atrazine; octylphenol | 7; 45; 83; 88; 98; 237; 245; 246; 247; 248; 249; 250 | Some chemicals are associated with both delayed and early puberty. For lead, delays in puberty are most marked in African- American and Mexican-American girls with blood lead concentrations 3 mg/dl |
| Alzheimer's | Geriatrics; Neurology | | | iron; lead; Pesticides; tellurium; aluminum; Solvents | 61; 80; 89; 203; 253 | Pesticide exposures as defined by occupational exposure (vineyard worker, farmer, farm worker, animal breeder) has been associated with Alzheimers. |
| Anemia (including hemolytic) | Hematology (Blood); Immunology | Anilines; arsine; benzene; copper; lead; Stibene (antimony); TNT (Trinitrotoluene) | arsenic; cadmium; mercury; naphthalene; Stibene (antimony); trimellitic anhydride | | | Arsine gas is produced when acid comes into contact with a metal containing arsenic and is used in crystal formation and in the semiconductor industry. Lead causes an acquired deficiency in pyrimidine-5' nucleoidase and severe toxicity is seen in individuals with the hereditary form of this deficiency. Naphthalene toxicity occurs most frequently in individuals with G6PD deficiency. |
| Angiosarcoma (hepatic) | Liver; Oncology (cancer) | arsenic+; vinyl chloride+ | Anabolic steroids; copper; thorium dioxide (Thorostat) | methylhydrazine; Nitrosamines; Pesticides; chlordimeform/4-COT; metam sodium; propylene oxide; pentachlorophenol (PCP); urethane; vinyl bromide#; vinyl fluoride# | | + - Group 1 human carcinogen, # - Group 2B human carcinogen (IARC) |
| Aplastic anemia | Hematology (Blood) | benzene; Ionizing radiation | arsenic; Ethylene glycols; gold; mercury; Solvents; carbon tetrachloride; Hydrocarbons; Kerosene; pentachlorophenol (PCP); Pesticides; dichlorvos; propoxur; TNT (Trinitrotoluene) | bismuth; Dinitrophenols; Pesticides; Organochlorine pesticides; chlordane; DDT/DDE; lindane; Organophosphates; parathion; perchlorate | 89; 122 | There are large variations in susceptibility to aplastic anemia which are poorly understood. In addition to the pesticides listed, unspecified pesticide exposure in applicators, manufacturers, and agricultural workers has been associated with aplastic anemia. In these situations, the individual is exposed to mixtures of pesticides or different pesticides at different times and associations between a specific pesticide exposure and disease can not be made. |

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|-------------------|----------------------------------|--|--|---|--------------------------------|--|
| Arrhythmias | Cardio-vascular | arsenic; antimony; carbon monoxide; Chlorofluorocarbons (CFCs); cyanide; Dihalomethanes; methylene chloride; Nitrates/Nitrites; Particulate air pollution (soot); Pesticides; Carbamates; Organophosphates; 1,1-dichloroethane | arsine; ethyl bromide; isopropyl chloride; lead; methyl bromide; Solvents; acetone; benzene; carbon tetrachloride; carbon disulfide; chloroform; 1,2-dichloroethane; ethyl chloride; methyl chloride; tetrachloroethylene (PCE); trichloroethane; trichloroethylene (TCE); toluene; xylene | barium; cadmium; cobalt; lanthanum; manganese; nickel; phosphorus | 48 | People with pre-existing coronary artery disease are more susceptible to the ischemic effects of carbon monoxide. Dichloromethane (methylene chloride) and dihalomethanes are metabolized to carbon monoxide in the body. Organic nitrates exposure (mainly in the explosives industry) includes ammonium, sodium nitrate, ethylene glycol dinitrate, nitroglycerin, and TNT and can cause cardiotoxicity in the absence of heart disease. Sudden cardiac death has been reported in glue sniffers. |
| Asbestosis | Respiratory | asbestos | | | | Diffuse interstitial pulmonary fibrosis caused by inhalation of asbestos fibers that may progress despite discontinuation of exposure and can have a latency period of 10-30 years. The incidence of asbestosis has diminished markedly with protective measures. |
| Asthma - allergic | Allergy; Immunology; Respiratory | Acid anhydrides; acrylates; Methacrylates; Amines; Ethanolamines; ethylenediamine; p-phenylenediamine; Animal antigens; captafol; Chlorothalonil; colophony; Enzymes; amylase; papain; subtilase; Egg lysosyme; pepsin; trypsin; Epoxy resins; Fungal antigens; Insect antigens; Isocyanates; Latex; Metal fumes; aluminum; Chromium; cobalt; nickel; platinum; tungsten carbide; vanadium; Plant pollens; Plastic fumes; Plastic dusts; PVC; polypropylene; Wood dust; Grain dust; Fiber dust; glutaraldehyde | Air pollution; Diesel exhaust; ozone; Aldehydes; acetaldehyde; acrolein; formaldehyde; propionaldehyde; Coal dust; Diazonium salts; ethylene oxide; hexachlorophene; Persulfate salts; Phenols; Pyrethins/Pyrethroids; Reactive dyes; sulfathiazole ; Tannic acid | aziridine; azodicarbonamide; Phthalates; senna; styrene | 5; 21; 148; 166; 183 | Allergens causing allergic asthma can also cause allergic rhinitis. Over 250 agents have been documented to cause immunological occupational asthma, a few broad categories are included here. The haplotype HLA DQB1*0503 is associated with TDI asthma, while allele DQB1*0501 confers protection to TDI. The Th2 type of T helper cells has been associated with an increased likelihood of developing allergies and asthma. Air pollutants may act in conjunction with common allergens to increase sensitivity to other common allergens. |
| Asthma - irritant | Immunology; Respiratory | Acids; Air pollution; Diesel exhaust; nitrogen dioxide; Particulate air pollution (soot); sulfur dioxide; ammonia; chlorine; Cotton dust; Ethylene amines; hydrogen sulfide; Tobacco smoke (Secondhand); Tobacco Smoke (Active smoking) | chloramine; Hydrazines; Oil fly ash; osmium tetraoxide; ozone; Pesticides; Organophosphates; Carbamates; phosgene; 1,1-dichloroethane | benzene; caprolactam; chloroform; dibromochloropropane (DBCP); dimethyl sulfate; Fragrances; Phthalates; dibutyl phthalate (DBP); dicyclohexyl phthalate; tetrachloroisophthalonitrile; toluene | 5; 8; 12; 21; 38; 39; 148; 166 | Numerous agents have been associated with asthma - a few are included here. Regarding air pollutants, nitrogen and sulfur oxides may exacerbate asthma in individuals with the disease, but have not been found to cause asthma in healthy individuals. However diesel exhaust, a major source of PM2.5 and nitrogen dioxide, has been causally associated with asthma. Ozone has been associated with both causing and exacerbating asthma. Risk of asthma is associated with both prenatal and postnatal exposure to secondhand smoke, and is clearly dose-related, with rates increasing with more smoking family members and in the homes of heavy smokers. Cigarette smoke resembles diesel exhaust and industrial emissions, containing a similar mix of tiny particles, thousands of toxic chemicals, and numerous respiratory irritants. Exposure to cigarette smoke and to outdoor air pollution may therefore cause similar asthmatic responses. |

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|--|---|--|--|---|---------------------------------------|--|
| Autoimmune antibodies (positive ANA, anti-DNA, RF, etc.) | Immunology; Allergy | silica | asbestos; mercury; Solvents; benzene; carbon tetrachloride; formaldehyde; trichloroethane; trichloroethylene (TCE) | cadmium; Chromium; copper; gold; lithium; Pesticides; Carbamates; chlorpyrifos; Organochlorine pesticides; chlordane; heptachlor; hexachlorobenzene; Phenoxyacetic herbicides; Pyrethins/Pyrethroids; pentachlorophenol (PCP); Silicone/Parafin breast implants; UV radiation; vinyl chloride | 5; 9; 23; 77; 98; 169 | Although the presence of auto-antibodies is a part of the diagnosis of autoimmune disease, the relevance of auto-antibodies in otherwise health individuals is unknown. Mercury-induced autoimmunity has a strong genetic component. Some strains of rats are completely resistant while others are exquisitely sensitive to mercury toxicity. Susceptibility has been linked to MHC and non-MHC genes. |
| Behavioral problems* | Neurology; Pediatrics; Developmental | ethyl alcohol (ethanol); cocaine; lead; mercury; PCBs | nicotine | Pesticides; Organophosphates | 58; 60; 80; 137 | *Includes aggression, impulsivity, and delinquent behavior |
| Benign prostatic hypertrophy | Genito-Urinary; Geriatrics; Male Reproduction | | | bisphenol A; Estrogens/DES | | |
| Berylliosis | Respiratory; Immunology | beryllium | | | | 13 Berylliosis is a granulomatous inflammatory disease similar to sarcoidosis, secondary to chronic beryllium exposure. May also involve skin, liver, spleen, salivary glands, kidney, and bone. A genetic predisposition to chronic beryllium disease. has been observed in the MHC II leukocyte antigen marker haplotype, HLA-DPB1, with a glutamic acid residue at position 69. |
| Black Lung Disease | Respiratory | Coal dust | | | | Coal worker's pneumoconiosis resulting from coal mine dust. |
| Bladder (neurogenic) | Neurology; Genito-Urinary | | B-dimethylaminopropionitrile (DMAPN)* | | | *used as a catalyst in the manufacture of polyurethane |
| Bladder cancer | Genito-Urinary; Oncology (cancer) | Aromatic amines; 4-Aminobiphenyl+; auramine; B-naphthylamine+; benzidine+; MOCA#; arsenic+; Benzidine-derived dyes#; direct blue 6; direct black 38; direct brown 95; chlordimeform/4-COT*; Coal tars+; nitrobiphenyl; 1,1-dichloroethane; Tobacco Smoke (Active smoking)+; PAHs | benzo(a)pyrene# (PAH's); chlornaphazine; Chlorophenols; Ionizing radiation; methylenedianiline; Solvents; o-toluidine#; Trihalomethanes; Chlorination byproducts | lead; antimony; asbestos; Chromium; p-cresidine^; Diesel exhaust#; Nitrosamines; tetrachloroethylene (PCE)#; Pesticides; cacodylic acid; Carbamates; carbaryl; propoxur; dichloropropene; Organochlorine pesticides; o-phenyl-phenol; Pyrethins/Pyrethroids; bifenthrin; saccharin; Dioxins/TCDD | 24; 52; 55; 84; 89; 98; 197; 198; 199 | + - Group 1 human carcinogen, # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC) *4-COT is the metabolite of chlordimeform Genetic differences in N-acetyltransferase, which detoxifies carcinogens, explain some variability in risk of disease. Individuals who are 'slow' acetylators have a greater susceptibility to bladder cancer than 'fast' acetylators. In addition to groups or individual pesticides listed, pesticide exposure in applicators, manufacturers and agricultural workers has been associated with bladder cancer. In these situations, the individual is exposed to mixtures of pesticides or different pesticides at different times. A correlation between an individual pesticide and disease can not be made. |
| Bone cancer/Ewings sarcoma | Musculo-skeletal; Oncology (cancer) | radium+ | Pesticides | benzene; beryllium; PAHs; PCBs; vinyl chloride; fluoride | | 36 + - Group 1 human carcinogen (IARC) Pesticide exposure in farmers and other occupations where diverse exposures to mixtures of pesticides can occur has been associated with sarcomas. In these studies, individual pesticides cannot be identified. Parental |
| Brain cancer (adult)* | Oncology (cancer); Neurology | Ionizing radiation | Chromium; methylene chloride^ | acrylonitrile; cadmium; Electromagnetic fields; ethylene oxide; iron; lead#; Oil mists; mercury; Solvents; benzene; carbon tetrachloride; tetrachloroethylene (PCE); trichloroethylene (TCE); toluene; xylene; pentachlorophenol (PCP); Pesticides; atrazine; 2,4-D; chlorpyrifos; hexachlorobenzene; Radiofrequency fields; vinyl chloride | 35; 40; 66; 81; 84; 89; 98; 173; 202 | *Includes gliomas, meningiomas, astrocytomas and other brain and CNS tumors. ' + - Group 1 human carcinogen, # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC). An increased incidence of brain ca has been observed in agriculture workers and farmers. |

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|--------------------------|--|---|--|---|---|---|
| Brain cancer - childhood | Neurology; Oncology (cancer); Pediatrics | Ionizing radiation | Solvents; Pesticides; dichlorvos; lindane; Tobacco smoke (Secondhand) | Aromatic amines; Chlorophenols; Dyes; Electromagnetic fields; Nitrosamines; Pesticides; carbaryl; diazinon; Phenoxyacetic herbicides | 35; 36; 40; 89; 202 | Parental exposure to aromatic amines in dyes and pigments, ionizing radiation, organic solvents, and pesticide exposure have been associated with an increased risk of childhood brain cancer. Parental exposure to EMF, paints or inks, and pesticides has been associated with neuroblastoma. In addition to groups or individual pesticides listed, pesticide exposure in the home or by parents at their occupations has also been associated with childhood brain ca. In these situations, the individual is exposed to mixtures of pesticides and a correlation between an individual pesticide and disease can not be made. |
| Breast cancer | Endocrine (Hormones); Female Reproduction; Oncology (cancer) | Estrogens/DES+; ethyl alcohol (ethanol); Ionizing radiation; Tobacco Smoke (Active smoking); Tobacco smoke (Secondhand)% | Aromatic amines; B-naphthylamine; benzidine; ethylene oxide; PAHs; PCBs*; Progestins^; Solvents; tetrachloroethylene (PCE) | acrylamide#; acrylonitrile; Dioxins/TCDD; Electromagnetic fields; Hydrazines^; Solvents; benzene; 1,3-butadiene; 1,2-dibromoethane; 1,1-dichloroethane; 1,2-dichloroethane^; 1,2-dichloropropane; methylene chloride^; trichloroethylene (TCE); 1,2,3-trichloropropane; Pesticides; Agent Orange; Organochlorine pesticides; aldrin; benzene; chlordane; DDT/DDE; dieldrin; mirex^; Herbicides; atrazine; cyanazine; oryzalin; propazine; simazine; tribenuron methyl; Phenoxyacetic herbicides; PhIP (2-amino-1-methyl-6-phenylimidazol(4,5-b)pyridine); styrene; vinyl chloride | 30; 33; 34; 41; 43; 80; 81; 98; 131; 180; 202 | + - Group 1 human carcinogen, # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC) Occupational exposure to vehicular exhaust was associated with an increased risk of breast cancer in males. Cigarette smoke, especially second-hand smoke, contains high levels of PAHs. Eleven constituents of cigarette smoke have been found to cause mammary gland carcinogens in animals. These chemicals include benzo[a]pyrene, dibenzo[a,l]pyrene, 2-toluidine, 4-aminobiphenyl, 2-amino-3-methylimidazoquinoline, 2-amino-1-methyl-6-phenylimidazopyridine, butadiene, isoprene, nitromethane, ethylene oxide, and benzene. % - secondhand smoke exposure in pre-menopausal women has been associated with breast cancer, but not in post-menopausal women. *-Genetic polymorphisms in the estrogen metabolizing enzyme, CYP1A1, may predispose some women to breast ca after PCB exposure. Women with a genetic variant in the NAT enzyme system (slow acetylators) have a 70% increased risk of breast cancer if they smoke. In contrast, the opposite genetic variant, or fast acetylators, have a doubling of breast cancer risk from exposure. |
| Bronchiolitis obliterans | Respiratory | diacetyl; Irritant gases; Nitrogen oxides; chlorine; phosgene; ozone; hydrogen sulfide; sulfur dioxide | Nylon fibers; Polyamide-amine dyes; acramin-FWN; thionyl chloride | | 20; 149; 150 | Acramin-FWN is found in paint aerosols that are used in the textile industry. It has been associated with an epidemic of bronchiolitis obliterans organizing pneumonia. Diacetyl is a food flavoring used to impart a buttery flavor to popcorn. |
| Bronchitis - acute | Respiratory | ammonia; chlorine; Chromium@; hydrochloric acid; mercury | beryllium; manganese; ozone; tellurium | Pesticides; Organochlorine pesticides; Organophosphates; vanadium | 89; 148 | Numerous agents have been associated with bronchitis, including the chemical agents listed here. @ - hexavalent chromium compounds |
| Bronchitis - chronic | Geriatrics; Respiratory | ammonia; aluminum; Coal dust; Isocyanates; Metals; antimony; iron oxide; osmium; vanadium; Oil mists; Organic dusts; Cotton dust; Hemp dust; Jute dust; Grain dust; Wood dust; Particulate air pollution (soot); Cement dust; silica; Fire smoke; Engine exhaust; sulfur dioxide; Welding fumes; Tobacco Smoke (Active smoking) | arsenic; carbon black; Grain dust; Solvents; PCBs; phosgene; 1,1-dichloroethane; Tobacco smoke (Secondhand) | Pesticides | 12; 88; 89; 168 | |

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| Brown lung disease (byssinosis) | Respiratory; Immunology | Cotton dust; Flax dust; Hemp dust; Jute dust; Sisal dust | | | | Has been applied to describe both acute and chronic response to exposure. |
| Carcinoid | Gastrointestinal; Oncology (cancer) | | | lead; Solvents | 14; 29 | |
| Cardiac congenital malformations* | Pediatrics; Developmental; Birth defects | ethyl alcohol (ethanol) | Anesthetic gases; Solvents; trichloroethylene (TCE); Tobacco smoke | benzene; carbon monoxide; 1,2-dichloroethane; Ethylene glycol ethers; Mineral oils; Pesticides; atrazine; Insecticides; Rodenticides; Organophosphates; Trihalomethanes; Chlorination byproducts | 57; 58; 68; 79; 89; 110; 202 | *Cardiac malformations include common truncus, transposition of the great vessels, tetralogy of Fallot, anomalies of the pulmonary valve, tricuspid and aortic valve anomalies, hypoplastic left heart, coarctation of the aorta, ventricular septal defects, atrial septal defects, interrupted aortic arch, anomalies of the pulmonary artery and an Ebstein anomaly. Trihalomethanes, including trichloroethylene, are found in drinking water as by-products of disinfection, usually by chlorine. Maternal pesticide exposure in the home or occupationally (farmers, agricultural workers) has been associated with CV malformations. Genetic polymorphisms in the solvent-metabolizing enzyme, glutathione-S-transferase, has been found to mediate the risks of organic solvents for the cardiac malformations, pulmonic valve stenosis and atrial septal defects. Cigarette smoking has been associated with CV malformations inconsistently, and in a sub-set of older mothers or those with a h/o miscarriage. |
| Cardiomyopathy | Cardio-vascular; Geriatrics | carbon monoxide; cobalt | arsenic; cadmium; lead | beryllium; Solvents | 51 | |
| Cataracts | Ophthalmology (Eye); Geriatrics | lead; UV radiation | ethylene oxide; Infrared radiation; Ionizing radiation; Microwave radiation; naphthalene; Tobacco smoke | Chlorophenols; Dioxins/TCDD; phosphine | 44; 162 | |
| Cerebral palsy | Neurology; Pediatrics; Developmental | mercury | | | 49; 60 | |
| Cerebrovascular disease (stroke) | Cardio-vascular; Geriatrics; Neurology | Tobacco Smoke (Active smoking); Tobacco smoke (Secondhand) | Air pollution; Estrogens/DES; Particulate air pollution (soot) | | 200 | |
| Cervical cancer | Female Reproduction; Genito-Urinary; Oncology (cancer) | DES+; Tobacco Smoke (Active smoking) | Solvents; Tobacco smoke (Secondhand) | Pesticides; dibromochloropropane (DBCP)^; tetrachloroethylene (PCE)#; trichloroethylene (TCE) | 29; 81; 117; 179 | # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC) Organic solvent exposure in dry cleaners and pesticide exposure in applicators has been associated with cervical ca. |
| Childhood Leukemias | Hematology (Blood); Oncology (cancer); Pediatrics | benzene+; Ionizing radiation+ | Agent Orange; Pesticides; Metal dusts; Chlorinated solvents; carbon tetrachloride; trichloroethylene (TCE); Tobacco smoke (Secondhand) | Electromagnetic fields; Air pollution; Vehicle exhaust; Pesticides; chlordane; dichlorvos; propoxur; radon | 32; 35; 36; 111; 113; 187; 202 | + - Group 1 human carcinogen (IARC) Parental exposure to ionizing radiation, metal dusts, organic solvents, pesticides, and hydrocarbons have been associated with increased rates of childhood leukemia. Also, childhood exposure to pesticides applied indo |
| Chloracne | Dermatology (Skin) | PBBs; PCBs; Phenoxyacetic herbicides; 2,4-D; 2,4,5-T; diuron; linuron; Organochlorine pesticides; DDT/DDE; Polyhalogenated naphthalenes; PCDFs; Dioxins/TCDD | pentachlorophenol (PCP) | | 11; 89 | |
| Choanal atresia | Pediatrics; Developmental; Birth defects | | | trichloroethylene (TCE) | 57 | Nasal defect--blockage of the nasal airway by bony or membranous tissue. Associated with trichloroethylene contamination of wells in Woburn, MA. |
| Cholangiocarcinoma | | | | | | ^ - Group 2B human carcinogen (IARC) |

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| Cholestasis | Liver; Gastrointestinal | Estrogens/DES; manganese; methylenedianiline | Ethylene amines; vinylidene chloride | 2,4-D; paraquat | 47 | |
| Chronic Fatigue Syndrome | Immunology; Neurology; Psychiatry | | | Pesticides; Organochlorine pesticides; Organophosphates; Solvents | 191 | A medically unexplained syndrome characterized by disabling fatigue accompanied by infectious, rheumatological, and neuropsychiatric symptoms. The causes are unknown but hypothesized to be multiple. |
| Chronic renal disease | Renal (kidney); Geriatrics | beryllium; lead; cadmium | 1,4-dichlorobenzene; Chromium; copper; mercury; silica; Organotins; paraquat | carbon disulfide; Solvents; phosphine; silver; uranium | 1; 52; 144 | Cadmium exposure in cigarette smokers is double (see acute tubular necrosis comments). Chronic renal disease from beryllium exposure occurs with multi-organ involvement (berylliosis). |
| Cirrhosis | Liver; Gastrointestinal | Aflatoxins; ethyl alcohol (ethanol); carbon tetrachloride; Chlorinated naphthalenes; PCBs; tetrachloroethane; TNT (Trinitrotoluene) | arsenic; halothane; Solvents; trichloroethylene (TCE) | formaldehyde; Hydrazines; N-nitrosodimethylamine; Pesticides; selenium; trichloroethane | 47 | Organic solvent exposure in shipyard workers, painters, and printers has been associated with cirrhosis. |
| Cognitive impairment (includes impaired learning, impaired memory, and decreased attention span)/Mental Retardation/Developmental Delay | Developmental; Neurology; Pediatrics | carbon disulfide; cocaine; ethyl alcohol (ethanol); lead; mercury; Tobacco smoke; nicotine; PCBs | carbon monoxide; Nitrates/Nitrites; PCBs; Solvents; tetrachloroethylene (PCE); trichloroethylene (TCE); styrene; toluene; xylene; Pesticides; Carbamates; methyl bromide; Organochlorine pesticides; Organophosphates; pentachlorophenol (PCP); 1,1-dichloroethane; Tobacco smoke (Secondhand) | sulfuryl fluoride; aluminum; arsenic; cadmium; dichloropropene; dieldrin; Dioxins/TCDD; fluoride; manganese; Organophosphates; chlorpyrifos; diazinon; Polybrominated Diphenyl Ethers (PBDEs) | 8; 49; 58; 59; 60; 61; 88; 89; 98; 137; 202; 203 | Cognitive impairment in children may occur as a result of exposures in utero or in early childhood during brain development. Metabolic studies have shown that infants absorb more manganese than adults. Manganese is added to infant formula. The effects of lead on I.Q. are non-linear and proportionally greater at lower concentrations. Canfield et al. found associated declines in I.Q. greatest at lifetime average blood lead concentrations less than 10 mg/dL. An estimated loss of 7.4 IQ points was calculated for lifetime average blood lead concentrations from 1 up to 10 mg/dL and a loss of 2.5 IQ points for concentrations 10-20 mg/dL |
| Colo-rectal cancer | Gastrointestinal; Oncology (cancer) | | alachlor; Aromatic amines; Chlorination byproducts; Ionizing radiation; Solvents; 1,1-dichloroethane | acrylonitrile; asbestos; Chlorophenols; Nitrosamines; PCBs; Pesticides; Organochlorine pesticides; aldrin/dieldrin; DDT/DDE; Organophosphates; chlorpyrifos; Phenoxyacetic herbicides; 2,4-D; 2,4,5-T; PAHs; PhIP (2-amino-1-methyl-6-phenylimidazol(4,5-b)pyridine); Dioxins/TCDD; toluene; xylene | 34; 36; 81; 89; 98; 118; 119; 123; 173; 198; 199 | Organic solvent exposure in commercial pressmen has been associated with colo-rectal cancer. Limited data showing association of colo-rectal ca in children with insecticide use. In addition to groups or individual pesticides listed, pesticide exposure in applicators, manufacturers and agricultural workers has been associated with colorectal ca. In these situations, the individual is exposed to mixtures of pesticides or different pesticides at different times and a correlation between an individual pesticide and disease can not be made. |
| Color vision disturbance | Neurology; Ophthalmology (Eye) | | carbon disulfide; Solvents | ethyl acetate; ethyl alcohol (ethanol); Organophosphate pesticides; styrene; tetrachloroethylene (PCE); toluene | 145 | |
| Congenital malformations - general | Pediatrics; Developmental; Birth defects | Anesthetic gases; ethyl alcohol (ethanol); Ionizing radiation | arsenic; carbon monoxide; Ethylene glycol ethers; mercury; Solvents; Tobacco smoke | bisphenol A; carbon disulfide; Chromic acid; ethylene oxide; pentachlorophenol (PCP); Pesticides; carbaryl; metam sodium; methyl bromide; vinyl chloride | 44; 89; 104; 110; 138; 202 | In addition to individual pesticides that have been identified in some epidemiological studies, maternal pesticide exposure in the home or occupationally (farmers, agricultural workers) has been associated with birth defects. The design of the majority of these studies were not able to identify specific pesticides associated with birth defects . |
| Contact dermatitis - Allergic | Dermatology (Skin); Immunology; Allergy | Antiseptics; Aromatic amines; Cement; Chromic acid; colophony; Cutting oils; Dyes; Epoxy resins; formaldehyde; Fragrances; Glues; Isothiazolins; Lanolins; Latex; Metals; Pesticides; potassium dichromate; Preservatives; Rubber products; Rhus antigens | | | 11; 50 | There are over 3,000 chemical agents which have been implicated as causal agents in allergic contact dermatitis, only broad categories are listed here. Rhus antigens are poisons oak, ivy or sumac |
| Contact dermatitis - Irritant | Dermatology (Skin); Immunology | aminotriazole; Abrasive dusts; Chromic acid; Cement; Coal tars; Detergents/Soaps; ethylene oxide; Metals; antimony; arsenic; Chromium; cobalt; nickel; mercury; zinc; Mild acids/alkalis; Pesticides; Solvents | | | 11; 50 | Over 65,000 chemical agents have been implicated as causal agents in irritant contact dermatitis, only broad categories are listed here. |

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| COPD (chronic obstructive pulmonary disease) | Geriatrics; Respiratory | Coal dust; Cement dust; Cotton dust; Particulate air pollution (soot); vanadium; Wood dust; Tobacco Smoke (Active smoking) | antimony; cadmium; Chromium; Grain dust; Irritant gases; Metal fumes; ozone; silica; sodium hydroxide; Tobacco smoke (Secondhand) | arsenic; ammonia; chlorine; manganese; nickel carbonyl; nitrogen dioxide; sulfur dioxide | 12; 148 | Cement dust, chlorine, coal dust, grain dust, cotton/hemp/flax dust, and sulfur dioxide have all been shown to act additively or multiplicatively with tobacco smoke to cause disease. |
| Coronary artery disease, peripheral vascular disease, atherosclerosis | Cardio-vascular; Geriatrics | lead; Tobacco smoke (Secondhand); Tobacco Smoke (Active smoking); carbon disulfide; Particulate air pollution (soot) | carbon monoxide; Dinitrotoluenes; mercury; TNT (Trinitrotoluene); Dioxins/TCDD; arsenic; cadmium | aluminum; Nitrates/Nitrites; PAHs; allylamine; B-aminopropionitrile; antimony; tungsten carbide | 48; 80; 109; 115; 123; 148; 252 | Organic nitrates exposure (mainly in the explosives industry) includes ammonium, sodium nitrate, ethylene glycol dinitrate, nitroglycerin, and TNT and can cause cardiotoxicity in the absence of heart disease. |
| Cranio- Facial malformations* | Pediatrics; Developmental; Birth defects | ethyl alcohol (ethanol); toluene | Ethylene glycol ethers; Ionizing radiation; mercury; Solvents; PCBs | cadmium; carbon disulfide; cyanazine; lead; methylazoxymethanol acetate; Organophosphate pesticides; tetrachloroethylene (PCE) | 46; 49; 59; 60; 104 | *Includes microcephaly, macrocephaly, gingival hyperplasia, wide saggital suture, facial edema, and exophthalmos. |
| Decreased Coordination/ Dysequilibrium* | Neurology; Pediatrics; Developmental | acrylamide; carbon disulfide; lead; mercury | aluminum; manganese; methyl bromide; Solvents; Pesticides; Organochlorine pesticides; chlordecone; Organophosphates; trichloroethylene (TCE) | styrene; toluene | 58; 98 | * includes visual-spatial skills, gross motor skills, gait and movement disorders |
| Decreased vision (includes blindness, retinopathy, optic neuropathy) | Neurology; Ophthalmology (Eye); Developmental | carbon monoxide; methanol | carbon disulfide; copper; Fungicides; methyl bromide; mercury; n-Hexane; Organotins | methylenedianiline; osmium tetroxide; Pesticides; Carbamates; carbofuran; Organochlorine pesticides; Organophosphates; 1,1-dichloroethane | 49; 58; 98; 178 | Methanol toxicity is due to formaldehyde and formate metabolic products. |
| Delayed growth | Musculo-skeletal; Pediatrics; Developmental | ethyl alcohol (ethanol) | lead; mercury; PCBs; toluene | manganese; pentachlorophenol (PCP); xylene | 7; 46; 49; 58 | |
| Dementia | Neurology; Geriatrics | | aluminum; carbon monoxide; thallium | tetrachloroethylene (PCE) | 159 | |
| Dermatomyositis | Dermatology (Skin); Immunology | | | silica; UV radiation | 23; 77 | |
| Diabetes - Type I | Cardio-vascular; Immunology; Endocrine (Hormones) | | N-3-pyridylmethyl-N'-p-nitrophenyl urea (Vacor) | Cow's milk proteins; Gluten; Nitrates/Nitrites; Nitrosamines; PCBs | 3; 4; 17 | Vacor is a rodenticide. |
| Diabetes - Type II | Cardio-vascular; Geriatrics; Endocrine (Hormones) | arsenic | Dioxins/TCDD; Tobacco smoke | DDT/DDE; iron | 3; 4; 19; 123 | |
| Dyslipidemia, hypercholesterolemia | Cardio-vascular; Metabolism | | carbon disulfide; Dioxins/TCDD; PCBs | | 80; 163 | |
| Early onset menopause | Endocrine (Hormones); Female Reproduction; Genito-Urinary | | Tobacco Smoke (Active smoking) | DDT/DDE; carbon disulfide; Pesticides; Organophosphates; PAHs | 98; 154; 223 | |
| Endometriosis | Developmental; Female Reproduction; Genito-Urinary | | PCBs | chlorodiphenyl ether; Dioxins/TCDD; Ionizing radiation; methoxychlor; 1,1-dichloroethane | 42; 69; 80; 135; 195; 223; 224 | |

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| Eosinophilia-myalgia syndrome | Immunology | | | 3-(Phenylamino)alanine | | 9 | Epidemic in New Mexico, 1989, caused by contamination of dietary supplement, L-tryptophan, with 3-(Phenylamino)alanine. Mortality rate 2.7%. Symptoms resembled connective tissue disease with myalgias, eosinophilia, and scleroderma-like skin disease. Etiology and syndrome similar to toxic oil syndrome. HLA-DR4 phenotype associated with chronic disease. |
| Erectile dysfunction | Neurology; Genito-Urinary; Male Reproduction | | carbon disulfide; B-dimethylaminopropionitrile (DMAPN) | lead; manganese; mercury; vinyl chloride; TNT (Trinitrotoluene) | | 56 | DMAPN - used as a catalyst in the manufacturing of polyurethane |
| Erythema multiforme | Dermatology (Skin) | | | Organophosphates | | 11 | |
| Esophageal cancer | Gastrointestinal; Oncology (cancer) | ethyl alcohol (ethanol); Tobacco Smoke (Active smoking)+ | Nitrosamines; Solvents; tetrachloroethylene (PCE)#; PAHs; silica | acrylamide^; Chromium; Pesticides | 81; 98 | | + - Group 1 human carcinogen, # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC). Organic solvent exposure in dry cleaners has been associated with esophageal ca, individual chemicals cannot be identified in these studies. Pesticide ex |
| Fetal Alcohol Syndrome/Fetal solvent syndrome | Pediatrics; Developmental; Birth defects | ethyl alcohol (ethanol); toluene | Solvents | Gasoline | 58; 60 | | |
| Fetotoxicity (Miscarriage/spontaneous abortion, stillbirth) | Developmental; Pediatrics; Reproduction | Anesthetic gases; ethyl alcohol (ethanol); Ethylene glycol ethers; ethylene oxide; Ionizing radiation; Tobacco smoke; nicotine; Tobacco Smoke (Active smoking) | Air pollution; carbon monoxide; nitrogen dioxide; sulfur dioxide; Particulate air pollution (soot); arsenic; carbon disulfide; DES; formaldehyde; lead; methyl isocyanate; mercury; Solvents; chloroform; methylene chloride; N-methylpyrrolidone (NMP); tetrachloroethylene (PCE); trichloroethane; trichloroethylene (TCE); toluene; xylene; Pesticides; dibromochloropropane (DBCP); Fungicides; Dithiocarbamates; Herbicides; glyphosate; Phenoxyacetic herbicides; Triazene herbicides; hexachlorobenzene; Organochlorine pesticides; DDT/DDE; paraquat; Triazene herbicides; Trihalomethanes; Chlorination byproducts; bisphenol A; Tobacco smoke (Secondhand) | glyphosate; hexachlorobenzene; metam sodium; Phenoxyacetic herbicides; Thiocarbamates; vanadium; cadmium; Phthalates; acrylamide; antimony; carbon tetrachloride; Chromic acid; Dioxins/TCDD; Electromagnetic fields; hydrogen sulfide; manganese; nickel; PCBs; pentachlorophenol (PCP); Pesticides; Arsenical pesticides; chlordecone; cyanazine; dinocap; dinoseb | 42; 56; 57; 67; 68; 71; 98; 114; 145; 146; 165; 202; 206; 210; 211; 213; 215; 219; 226; 228; 229 | | Anesthetic gases include halothane, nitrous oxide and ethane. Toluene, nitrous oxide, and ethylene oxide exposure in a male have been associated with miscarriage in the female partner. Trihalomethanes, including bromodichloromethane, are found in drinking water as by-products of disinfection (usually by chlorine). Pesticide exposure occupationally such as in farming and pesticide application in the home has been associated with spontaneous abortion and stillbirth. While some studies have investigated particular pesticides, most studies do not identify individual pesticide or classes of pesticides. |
| Flock workers disease | Respiratory | | Nylon fibers | | | 15; 20 | |
| Gallbladder cancer | Gastrointestinal; Oncology (cancer) | | thorium dioxide (Thorostat) | Dinitrotoluenes^; Organochlorine pesticides; benzene; DDT/DDE; PCBs | | 120 | ^ - Group 2B human carcinogen (IARC). In addition to individual pesticides listed, exposure to pesticides by applicators, manufacturers and agricultural workers has been associated with gallbladder ca. In these situations, the individual is exposed to mixtures of pesticides or different pesticides at different times and a correlation between individual pesticides and disease can not be made. |
| Genito-urinary malformations (includes male and female) | Developmental; Genito-Urinary; Pediatrics; Reproduction | DES | Pesticides; Tobacco smoke | Solvents; diisononyl phthalate; Ethylene glycol ethers; trichloroethylene (TCE); linuron; toluene; heptachlor epoxide; hexachlorobenzene; Dioxins/TCDD; bisphenol A; arsenic; cadmium; Estrogens/DES; Pesticides; atrazine; chlordecone; molinate; vinclozolin; Phthalates; benzyl butyl phthalate (BBP); dibutyl phthalate (DBP); di (2-ethylhexyl) phthalate (DEHP)/MEHP | 68; 76; 89; 110; 174; 202; 204; 210; 219; 233; 234; 236; 238 | | Maternal pesticide exposure in agricultural workers has been associated with cryptorchidism. Paternal pesticide exposure has been associated with cryptorchidism as well. |

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| Glomerulonephritis | Renal (kidney); Immunology; Pediatrics | | fluoride; gold; lead; mercury; Solvents; silica | carbon disulfide; Hard metal; paraquat | 23; 52; 160 | Hard metal is an alloy of tungsten carbide and cobalt. |
| Gout | Musculo-skeletal; Geriatrics | lead | | | | |
| Granulomatous disease (liver) | Liver; Gastrointestinal | | beryllium; copper | Cement dust; mica; silica | 47 | |
| Gulf War Syndrome | Immunology; Neurology; Psychiatry | | | Pesticides; diethyl-m-toluamine (DEET); lindane; permethrin; pyridostigmine bromide | 190 | The case definition of Gulf War Syndrome remains somewhat broad as do the potential causes. Symptoms may include chronic fatigue, joint and muscle aches, and gastrointestinal symptoms. Some studies implicate co-exposures to insecticides and a nerve-gas protective agent (PB) as contributory. There is evidence that pesticides, caffeine and adrenergic agents potentiate the effects of PB. |
| Hard metal disease | Respiratory; Immunology | cobalt | | | | Hard metal are alloys of tantalum, titanium, and tungsten carbide. |
| Hashimoto's (Autoimmune) thyroiditis | Immunology; Endocrine (Hormones) | | DES; iodine | Silicone/Parafin breast implants | 22; 23 | |
| Hearing loss | Neurology; Geriatrics; Ear, Nose, and Throat | carbon disulfide; ethyl alcohol (ethanol); Metals; arsenic; cobalt; lead; lithium; mercury; thorium; Noise | Anilines; carbon monoxide; DDT/DDE; cyanide; dimethyl sulfoxide; Dinitrophenols; iodine; Jet fuel; JP-4; Solvents; benzene; carbon tetrachloride; trichloroethylene (TCE); styrene; toluene; xylene; Organotins; propylene glycol | PCBs | 49; 88; 184 | Co-exposure to noise and solvents may have a combined effect on hearing loss. |
| Hepatocellular cancer (Liver cancer) | Liver; Oncology (cancer) | aflatoxin B1 (Aflatoxins)+; Androgens; N-nitrosodimethylamine; ethyl alcohol (ethanol); Hydrocarbons | arsenic; captafol#; PCBs#; thorium dioxide (Thorostat); trichloroethylene (TCE)#; vinyl chloride | benzene; p-dichlorobenzene^; 1,4-dioxane^; Dinitrotoluenes^; Furans^; Hydrazines^; isoprene^; MTBE; Nitrosamines; PBBs^; Pesticides; chlordimeform/4 COT; dibromochloropropane (DBCP); dichloropropene; Fungicides; benomyl; cyproconazole; ethylene thiourea (ETU); furancarboxamide; hexachlorobenzene; iprodione; prochloraz; propiconazole; tebuconazole; triadimefon; triadimenol; uniconazole; Herbicides; acifluorfen; amitrole; bromacil; bromoxynil; chloramben; dichlobenil; diclofop-methyl; furmecyclox; haloxyfop-methyl; lactofen; metolachlor; nitrofen; oxadiazon; oxadixyl; oxyfluorfen; Phenoxyacetic herbicides; pronamide; quizalofop-ethyl; triallate; metam sodium; Organochlorine pesticides; aldrin; chlordane; chlordane^; heptachlor^; DDT/DDE^; dicofol; endrin; Halogenated hydrocarbons^; lindane^; mirex^; toxaphene; Organophosphates; acephate; tetrachlorovinphos; pentachlorophenol (PCP); permethrin; Solvents; carbon tetrachloride^; chloroform^; formalin; methylene chloride^; tetrachloroethylene (PCE)^; TCDD^; tetrafluoroethylene^; vinyl bromide#; vinyl fluoride | 29; 47; 81; 89; 131 | + - Group 1 human carcinogen (IARC), # - Group 2A human carcinogen (IARC), ^ - Group 2B human carcinogen (IARC). Note: many chemicals cause liver cancer in laboratory animals and the list here is incomplete. |
| Hepatoma | Liver; Gastrointestinal | Estrogens/DES | | hexachlorobenzene; mirex; MTBE | 126 | |
| Hepatoportal Sclerosis | Liver; Gastrointestinal | | arsenic; thorium dioxide (Thorostat); vinyl chloride | | | A rare form of non-cirrhotic periportal fibrosis resulting in portal hypertension. |

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| Hodgkin's Disease (lymphoma) | Hematology (Blood); Oncology (cancer) | | Chlorophenols; Phenoxyacetic herbicides^; Dioxins/TCDD; Agent Orange | Creosotes; ethylene oxide; Solvents; trichloroethylene (TCE); Pesticides; Organochlorine pesticides; aldrin; DDT/DDE^; lindane; 1,1-dichloroethane | 29; 36; 84; 98; 123; 187 | ^ - Group 2B human carcinogen (IARC). In addition to groups or individual pesticides listed, pesticide exposure in applicators, manufacturers and agricultural workers has been associated with Hodgkin's lymphoma. In these situations, the individual is exposed to mixtures of pesticides or different pesticides at different times and a correlation between an individual pesticide and disease can not be made. |
| Hormonal changes (levels of circulating sex hormones - FSH/LH, Inhibin, and/or estrogens, progesterones, androgens) | Endocrine (Hormones); Female Reproduction; Male Reproduction | dibromochloropropane (DBCP); ethyl alcohol (ethanol) | 2-bromopropane; lead; Pesticides; Organophosphates; parathion; methamidophos; Fungicides; vinclozolin; Dioxins/TCDD; vinyl chloride; cadmium; Tobacco Smoke (Active smoking); Tobacco smoke (Secondhand); xylene; toluene; Phthalates | mercury; octylphenol; PBBs; PCBs; styrene; acrylamide; atrazine; bisphenol A; carbon disulfide; DDT/DDE; Ethylene glycol ethers; manganese | 42; 45; 56; 75; 80; 89; 102; 104; 134; 143; 165; 171; 194; 202; 204; 210; 219; 221; 222; 230; 231; 240; 242 | Herbicide applicators and fungicide use in males has been associated with changes in FSH and LH serum levels. |
| Hyperkeratosis/ Hyperpigmentation | Dermatology (Skin) | arsenic; Coal tars; Coal tars; Asphalt; Creosotes; Petrochemicals; hexachlorobenzene | | PCBs | | |
| Hypertension (High blood pressure) | Cardio-vascular; Geriatrics | carbon disulfide; lead | arsenic; carbon monoxide; thallium | cadmium; Phenoxyacetic herbicides; DDT/DDE; mercury; PCBs; Dioxins/TCDD; vinyl chloride | 2; 48; 51; 80; 82; 123 | Arsenic in drinking water has been associated with hypertension. |
| Hypoactivity | Neurology; Psychiatry | | | cadmium; PCBs; styrene | | |
| Immune suppression * | Allergy; Immunology; Oncology (cancer) | benzene; Ionizing radiation; Dioxins/TCDD; Tobacco smoke (Secondhand); UV radiation; Tobacco Smoke (Active smoking) | asbestos; PAHs; benzo(a)pyrene; lead; mercury; methyl isocyanate; nickel; nitrogen dioxide; PBBs; PCBs; PCDDs; PCDFs; Pesticides; Organophosphates; chlorpyrifos; dichlorvos; Organochlorine pesticides; chlordane; Carbamates; aldicarb; phosgene; pentachlorophenol (PCP) | arsenic; beryllium; cadmium; Chromium; copper; Estrogens/DES; DES; Diesel exhaust; Nitrosamines; nitrogen dioxide; ozone; Pesticides; atrazine; hexachlorobenzene; Organotin; tributyl tin oxide; triphenyltin; Phenoxyacetic herbicides; 2,4-D; platinum; silica; Solvents; carbon tetrachloride; Ethylene glycol ethers; formaldehyde; tetrachloroethylene (PCE); toluene; trichloroethane; trichloroethylene (TCE); sulfur dioxide; titanium dioxide; urethane; vinyl chloride | 22; 23; 60; 77; 89; 98; 125; 171; 202 | * Broad non-specific category that includes decreased levels of circulating immune cells (including white blood cells), decreased levels of circulating antibodies, altered cell function, decreased immune response, decreased resistance to infection, and increased tumor susceptibility. In mice, allelic variation in the Ah receptor has been shown to confer different sensitivities to TCDD. At high concentrations, metals usually exert immunosuppressive effects; however, at lower concentrations immunoenhancement has been observed. |
| Itai-itai disease | | cadmium | | | | A combination of osteomalacia and osteoporosis caused by the consumption of cadmium contaminated rice in |
| Laryngeal cancer | Ear, Nose, and Throat; Oncology (cancer); Respiratory | ethyl alcohol (ethanol); PAHs; sulfuric acid+; Tobacco Smoke (Active smoking); Mineral oils | asbestos; diethyl sulfate#; Leather dust; Mustard gas; nickel; Wood dust | acetaldehyde^; formaldehyde; Pesticides; Agent Orange; Petrochemicals; vinyl chloride | 28; 187 | + - Group 1 human carcinogen, # - Group 2A human carcinogen (IARC) |
| Leukoderma (hypopigmentation) | Dermatology (Skin) | Catechols; Creosotes; Hydroquinones; Alkyl phenols | ethylene oxide | Carbamates; carbyne | | 11 |
| Low birth weight/Small for Gestational Age/Intra-Uterine Growth Retardation | Pediatrics; Reproduction; Developmental | cocaine; ethyl alcohol (ethanol); nicotine; Tobacco smoke; Tobacco smoke (Secondhand); 1,1-dichloroethane | Air pollution; carbon monoxide; Particulate air pollution (soot); arsenic; DES; lead; mercury; nicotine; Noise; Solvents; toluene; PCBs; pentachlorophenol (PCP); Pesticides; Herbicides; atrazine; cyanazine; metolachlor; Organochlorine pesticides; DDT/DDE; lindane; Organophosphates; chlorpyrifos; diazinon; Trihalomethanes; Chlorination byproducts | carbon tetrachloride; ethylene oxide; N-methylpyrrolidone (NMP); Perfluorinated acids; Phenoxyacetic herbicides; 2,4,5-T; Dioxins/TCDD; tetrachloroethylene (PCE); trichloroethylene (TCE); 1,1-dichloroethane | 56; 57; 58; 60; 67; 89; 103; 106; 114; 145; 148; 166; 172; 202 | Trihalomethanes are found in drinking water as by-products of disinfection, usually by chlorine. Carbon tetrachloride, Tetrachloroethylene and trichloroethylene as contaminants of drinking water |
| Lung cancer | Oncology (cancer); Respiratory | aluminum; arsenic+; asbestos+; attapulgite; PAHs; benzo(a)pyrene#; beryllium+; cadmium+; Chloromethyl ethers+; chromium (VI)+; Coal tars+; Diesel exhaust#; Ionizing radiation; Mineral oils+; Mustard gas+; nickel+; Particulate air pollution (soot); radon+; silica+; Particulate air pollution (soot)+; Tobacco smoke (Secondhand)+; uranium; Tobacco Smoke (Active smoking)+ | Acid aerosols; Aromatic amines; Chlorophenols; Coal dust; copper; dimethyl sulfate#; epichlorohydrin#; formaldehyde; Solvents; Nitrosamines; NNK; PAHs; benz(a)anthracene#; dibenz(a,h)anthracene# | daminozide (Alar); diazinon; dibromochloropropane (DBCP)^; dichloropropene; Herbicides; Agent Orange; metolachlor; paraquat; pendimethalin; Phenoxyacetic herbicides; Organochlorine pesticides; chlordane^; DDT/DDE^; Pyrethins/Pyrethroids; cypermethrin; permethrin; terrazole; styrene^; Talc; Dioxins/TCDD^; tetrachloroethylene (PCE); trichloroethylene (TCE); tetranitromethane^; urethane; vinyl chloride; acrylonitrile^; acrylamide; antimony^; benzene; bromoform; Ceramic fibers^; cobalt^; 1,2-dichloroethane^; ethylene oxide; fluoride; formaldehyde; Glasswool^; Rockwool^; Slagwool^; Hydrazines^; hydrochloric acid^; isoprene^; lead#; methylene chloride^; Nitrobenzenes; nitrosomorpholine; Pesticides; cacodylic acid; Carbamates; chlorpyrifos | 21; 29; 31; 65; 81; 89; 98; 123; 164; 166; 173; 176; 187; 202 | + - Group 1 human carcinogen, # - Group 2A human carcinogen, ^ - Group 2B human carcinogen, ' - Group 3 human carcinogen (IARC). NNN and NNK are tobacco specific nitrosamines. In addition to groups or individual pesticides listed, pesticide exposure |

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| Lymphoma (non-Hodgkin's) | Hematology (Blood); Oncology (cancer) | benzene; 1,3-butadiene#; Dioxins/TCDD+ | Aromatic amines; Chlorophenols; Creosotes; Ionizing radiation; Solvents; carbon disulfide; carbon tetrachloride^; trichloroethylene (TCE)#; tetrachloroethylene (PCE)#; PCBs; Pesticides; Agent Orange; Carbamates; carbaryl; dicamba; Fungicides; captan; Organophosphates; dichlorvos; malathion; Insecticides; lindane; Organochlorine pesticides; aldrin; DDT/DDE^; 2,4-D; MCPA; mecoprop; Chlorophenols^; Phenoxyacetic herbicides^; Tobacco smoke (Secondhand) | asbestos; MTBE; 1,2-dichloroethane^; pentachlorophenol (PCP); Pesticides; Herbicides; alachlor; atrazine; glyphosate; Organochlorine pesticides; aldrin; dieldrin; chlordane; heptachlor^; lindane; toxaphene; UV radiation; Vehicle exhaust | 26; 27; 29; 36; 84; 89; 98; 123; 126; 127; 128; 133; 177; 187; 202 | + - Group 1 human carcinogen,# - Group 2A human carcinogen,^ - Group 2B human carcinogen (IARC). Parental exposure to ionizing radiation and pesticides have been associated with NHL in children. |
| Macular degeneration | Ophthalmology (Eye); Geriatrics | | Tobacco smoke | UV radiation | | |
| Melanoma (skin cancer) | Dermatology (Skin); Oncology (cancer); Ear, Nose, and Throat | UV radiation | | Agent Orange; asbestos; carbon tetrachloride; formaldehyde; PAHs; PCBs; Pesticides | 11; 84; 98; 140; 188 | Pesticide, carbon tetrachloride, asbestos, and formaldehyde exposure have been associated with intra-ocular melanomas. Pesticide exposure in applicators and farm workers has been associated with melanoma. In these situations, the individual is exposed to mixtures of pesticides or different pesticides at different times and a correlation between an individual pesticide and disease can not be made. |
| Menstrual disorders (abnormal bleeding, short cycles, long cycles, irregular cycles, painful periods) | Endocrine (Hormones); Female Reproduction; Genito-Urinary | Ionizing radiation | benzene; 2-bromopropane; ethyl alcohol (ethanol); Dioxins/TCDD; lead; mercury; Solvents; carbon disulfide; formaldehyde; tetrachloroethylene (PCE); toluene; xylene; PCBs; Pesticides; hexachlorobenzene; Organochlorine pesticides; DDT/DDE; lindane; chlordane; toxaphene; Organophosphates; Trihalomethanes; Chlorination byproducts; Fungicides; maneb; mancozeb; Herbicides; atrazine; Tobacco smoke (Secondhand); Estrogens/DES | TNT (Trinitrotoluene); Phthalates; antimony; bisphenol A; boron; cadmium; Petrochemicals; styrene; thallium | 42; 70; 80; 98; 112; 175; 193; 207; 210; 212; 219 | Menstrual disorders includes abnormal bleeding: hypermenorrhea/menorrhagia, ammenorrhea/oligomenorrhea, irregular cycles/metorrhagia, dysmenorrhea, |

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| Mesothelioma | Respiratory; Oncology (cancer) | asbestos+; erionite+ | Ionizing radiation; zeolite | beryllium; Ceramic fibers; ethylene oxide; nickel; propylene oxide; silica; Talc | 15 | + - Group 1 human carcinogen. Latency can be 30-50 years after asbestos exposure. Mesothelioma rates due to asbestos are expected to peak 2010-2030. |
| Metal fume fever | Respiratory; Immunology | magnesium; zinc oxide | copper | arsenic; boron; cadmium; manganese; nickel; tin; titanium | 16 | Acute, self-limiting flu-like illness common in welders. |
| Methemoglobinemia | Hematology (Blood) | Anilines; Chlorate salts; copper; naphthalene; Nitrates/Nitrites; TNT (Trinitrotoluene) | Nitrobenzenes; nitroethane; Nitrotoluenes; p-dichlorobenzene; toluidine; 1,1-dichloroethane | Chromic acid | | Anilines are fat-soluble and readily penetrate intact skin through clothing and also can be inhaled as vapor. Chlorate salts are used primarily in pesticides and herbicides. |
| Minamata disease | Neurology; Pediatrics; Developmental | mercury | | | | Prenatal exposure to MeHg resulting in MR, CP, microcephaly and seizures. |
| Multiple Chemical Sensitivity | Immunology; Neurology; Psychiatry | | | Pesticides; Solvents; Cleaning agents; Fragrances; Vehicle exhaust | 151 | A generalized, non-organ specific collection of symptoms that recur and abate in response to stimuli, often at very low levels and triggered by chemicals and olfactory stimuli. Substances listed are triggers for symptoms. The pathophysiology of MCS is not well understood. |
| Multiple myeloma | Hematology (Blood); Oncology (cancer) | benzene; Ionizing radiation | Dioxins/TCDD; Pesticides; Arsenical pesticides; Phenoxyacetic herbicides | Agent Orange; asbestos; DDT/DDE; Fungicides; Heavy metals; Solvents; trichloroethane; trichloroethylene (TCE); Petrochemicals | 27; 81; 84; 89; 98; 123; 131; 187 | Organic solvent exposure in painters has been associated with multiple myeloma. In addition to the pesticides listed, unspecified pesticide exposure in applicators, manufacturers, and agricultural workers has been associated with multiple myeloma. In these situations, the individual is exposed to mixtures of pesticides or different pesticides at different times. Associations between a specific pesticide exposure and disease can not be made. |
| Multiple Sclerosis | Immunology; Neurology; Immunology; Musculoskeletal; Neurology | | | Silicones; Solvents; Ionizing radiation; Solvents; Pesticides; chlordane; Organophosphates | 72; 73; 74; 77 | A reduced risk of MS mortality has been shown in occupations with exposure to sunlight. Occupational solvent exposure has been associated with MS. |
| Mycosis fungoides (cutaneous T-cell lymphoma) | Dermatology (Skin); Oncology (cancer) | | Pesticides; Organophosphates | Metals; Petrochemicals; Solvents; Pesticides; glyphosate | 37; 89; 133 | A chronic cutaneous T-cell lymphoma (non-Hodgkins). |
| Myelodysplastic syndrome (pre-leukemia) | Hematology (Blood); Oncology (cancer) | benzene; Ionizing radiation | ethyl alcohol (ethanol); Solvents; Pesticides; Diesel exhaust; Tobacco Smoke (Active smoking) | ammonia; arsenic; Dusts; asbestos; silica; Formica; Electromagnetic fields; Metals; copper; nickel; Steel; tin | 90; 91; 92 | This condition is associated with chromosomal aberrations, especially deletions in chromosomes 5 and 7. Damage to these chromosome has been induced in vitro (test tube) using benzene metabolites on peripheral blood lymphocytes. Pesticides and organic solvents have also been postulated to cause aberrations in chromosomes 5 and 7. Occupational exposure to solvents (paints, varnishes, solvents and glues), pesticides (insecticides, weed killers), and petroleum products (diesels, petrols, oils, greases, dyes, inks and colourings) have been associated with MDS. |
| Myocardial infarction (Heart attack) | Cardio-vascular; Geriatrics | carbon disulfide; carbon monoxide; cyanide; Dihalomethanes; hydrogen sulfide; methylene chloride; Nitrates/Nitrites; Particulate air pollution (soot); Tobacco smoke (Secondhand); Tobacco Smoke (Active smoking) | arsenic; styrene | mercury; nickel; phosphine | 48; 144; 148 | People with pre-existing heart disease are more susceptible to the ischemic effects of carbon monoxide. Dichloromethane (methylene chloride) and dihalomethanes are metabolized to carbon monoxide in the body. Organic nitrates exposure (mainly in the explosives industry) includes ammonium, sodium nitrate, ethylene glycol dinitrate, nitroglycerin, and TNT and can cause cardiotoxicity in the absence of heart disease. |
| Nasal polyps | Respiratory; Ear, Nose, and Throat | Chromium; Wood dust | | | | |
| Nasal septal perforation | Respiratory; Ear, Nose, and Throat | Chromium | arsenic; beryllium; copper; nickel | antimony | | |

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| Nasopharyngeal/Sino-Nasal cancer | Ear, Nose, and Throat; Oncology (cancer); Respiratory | chromium (VI)+; formaldehyde+; Leather dust; nickel+; Wood dust; Tobacco Smoke (Active smoking)+; Tobacco smoke (Secondhand) | diisopropyl sulfate; Isopropyl oils; PAHs | acetaldehyde^; benzene; Chlorophenols; 1,4-dioxane^; hexamethylphosphoramide; Hydrazines^; Mustard gas; naphthalene^; Nitrosamines; pentachlorophenol (PCP); Pesticides; dibromochloropropane (DBCP)^; ethylene dibromide (EDB)#; acetochlor; alachlor; 2,4,5-T; propylene oxide; radium; MCPA; Herbicides^ | 25; 81; 89; 98 | + - Group 1 human carcinogen, # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC) |
| Nephrotic syndrome | Renal (kidney); Immunology | | cadmium; gold; lead; Phenols; phosphorus | mercury; Solvents; carbon disulfide; carbon tetrachloride; formaldehyde; trichloroethylene (TCE) | 52 | Cadmium exposure in cigarette smokers is double (see acute tubular necrosis comments). |
| Neural tube defects/CNS malformations* | Birth defects; Neurology; Pediatrics | | arsenic; Chlorophenols; mercury; Trihalomethanes; Chlorination byproducts | benzene; cadmium; copper; Chlorophenols; hydrogen cyanide; manganese; Pesticides; Agent Orange; 2,4-D; 2,4,5-T; benomyl; chlordecone; ethylene thiourea (ETU); Solvents; chloroform; Ethylene glycol ethers; trichloroethylene (TCE); toluene; vinyl chloride; vinylidene chloride; Tobacco smoke | 57; 89; 110; 132; 141; 202 | *Includes eye malformations (congenital cataracts), anencephaly, and hydrocephaly. Trihalomethanes are found in drinking water as by-products of disinfection, usually with chlorine. Carbon tetrachloride and trichloroethylene as drinking water contaminants. Maternal pesticide exposure in agricultural workers and in the home have been associated with NTD. Individual pesticide exposure was not identified in these studies. |
| Neurosthenia (Organic affective syndrome) | Neurology; Psychiatry | | Solvents | acrylamide; arsenic; lead; manganese; mercury; n-Hexane; methyl chloride; toluene | | Characterized by symptoms of irritability, fatigability, difficulty in concentrating, loss of interest in daily events. |
| Olfactory alterations (hyposmia, anosmia, dysomias) | Neurology; Ear, Nose, and Throat | Acids; ammonia; Hydrocarbons; Metals; antimony; cadmium; nickel; Solvents | | | | |
| Oral cancer | Respiratory; Oncology (cancer); Ear, Nose, and Throat | Tobacco smoke+; Smokeless tobacco products+ | ethyl alcohol (ethanol); Nitrosamines; NNN; NNK | acetaldehyde^; PAHs | | + - Group 1 human carcinogen, ^ - Group 2B human carcinogen (IARC) NNN and NNK are tobacco specific nitrosamines. |
| Oral cancer | Ear, Nose, and Throat; Oncology (cancer); Respiratory | Smokeless tobacco products+; Tobacco Smoke (Active smoking)+ | ethyl alcohol (ethanol); Nitrosamines; NNN; NNK | acetaldehyde^; PAHs | | + - Group 1 human carcinogen, ^ - Group 2B human carcinogen (IARC) NNN and NNK are tobacco specific nitrosamines. |
| Oral clefts (cleft lip and palate) | Pediatrics; Developmental; Birth defects | | ethyl alcohol (ethanol); Tobacco smoke | cadmium; Pesticides; Agent Orange; 2,4-D; 2,4,5-T; dinoseb; Solvents; carbon tetrachloride; chloroform; 1,2-dichloroethane; Ethylene glycol ethers; trichloroethylene (TCE); Dioxins/TCDD; Trihalomethanes; Chlorination byproducts | 57; 78; 89 | Parental pesticide exposure in the home and occupationally in agricultural workers has been associated with oral clefts. Environmental exposure to alcohol, tobacco smoke or dioxins may interfere with gene expression (TGFA and TGFB3) required for palate and lip formation. Trihalomethanes, including chloroform, are found in drinking water as by-products of disinfection (usually by chlorine). Carbon tetrachloride and trichloroethylene as drinking water contaminants. |
| Osteomalacia | Musculo-skeletal | | aluminum; cadmium | | | cadmium - related to calcium and phosphorus wasting and impaired synthesis of Vitamin D. |
| Osteoporosis | Geriatrics; Musculo-skeletal | cadmium | Tobacco Smoke (Active smoking); fluoride | lead | 46 | Lead accumulates in bone and increased exposure may result in women during times of increased bone turnover (e.g. pregnancy, lactation, and menopause) |
| Osteosclerosis | Musculo-skeletal | hydrofluoric acid | fluoride | | | |
| Ovarian atrophy | Genito-Urinary; Female Reproduction | | 1,3-butadiene | | 155 | |
| Ovarian cancer | Oncology (cancer); Genito-Urinary; Female Reproduction | | Ionizing radiation | Aromatic amines; Dyes; asbestos; Diesel exhaust; Solvents; Pesticides; calcium cyanamide; Triazene herbicides; Talc | 84; 98; 201 | |

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| Pancreatic cancer | Gastrointestinal; Oncology (cancer) | Tobacco Smoke (Active smoking)+ | ethylan; Ionizing radiation; nitrophenol; Solvents; PAHs; PCBs; pentachlorophenol (PCP); Pesticides; DDT/DDE; Fungicides; Herbicides; 1,1-dichloroethane | acrylamide; acrylonitrile; cadmium; chlorhydrin; Chromium; ethylene oxide; Nitrosamines; NNK; Pesticides; Fungicides; Herbicides; nitrofen; Organophosphates; parathion; quinclorac; silica; Solvents; carbon tetrachloride; formaldehyde; methylene chloride^; styrene; tetrachloroethylene (PCE); trichloroethylene (TCE); vinyl chloride | 29; 63; 81; 95; 96; 121; 131; 164 | + - Group 1 human carcinogen (IARC) Organic solvent exposure in commercial pressmen and dry cleaners. NNK is a tobacco specific nitrosamines One case-control study found an association between organochlorine levels and K-ras mutations in pancreati |
| Pancreatitis | Gastrointestinal; Endocrine (Hormones) | ethyl alcohol (ethanol) | dimethylformamide; Ethylene glycols; methanol; Organophosphates | carbon tetrachloride; cobalt; Diesel exhaust; pentachlorophenol (PCP); trichloroethylene (TCE) | 18 | |
| Parkinson's disease/Movement disorders | Neurology; Geriatrics | manganese; MPTP | carbon disulfide; carbon monoxide; methanol; Pesticides; paraquat | aluminum; iron; n-Hexane; PCBs; Pesticides; diquat; glyphosate; rotenone; maneb; mancozeb; Organochlorine pesticides; dieldrin; Organophosphates; Pyrethins/Pyrethroids | 61; 80; 89; 158; 202; 203 | Parkinsonism symptoms include tremor, rigidity, gait disturbances, bradykinesia, and impairment of postural reflexes. Pesticide exposures as defined by occupational exposure (vineyard worker, agricultural worker, farmer, animal breeder, pesticide applicator) or inferred by rural residences or well water as source of drinking water has been associated with PD. Several population based case-control studies have identified a 3-4 fold increased likelihood of PD with past herbicide or insecticide exposure. Paraquat has a structure similar to MPTP. A possible role of gene-pesticide interactions in the etiology of PD has been postulated with reports of associations between glutathione transferase polymorphisms, NAT-2 slow acetylators, and slow 4-hydroxylation of debrisoquine (CYP 2D6 29B+) and PD. These genetic variants may increase risk from environmental exposure by slowing detoxification of exogenous compounds. |
| Peripheral neuropathy | Musculo-skeletal; Neurology | acrylamide; arsenic; ethylene oxide; Hydrocarbons; n-Hexane; methyl n-butyl ketone; lead; mercury; Pesticides; Carbamates; aldicarb; Organophosphates* pesticides; Pyrethins/Pyrethroids; fenvalerate; thallium | carbon disulfide; cyanide; B-dimethylaminopropionitrile (DMAPN); manganese; nitrous oxide; PCBs; Pesticides; Organochlorine pesticides; chlordane; chlordecone; DDT/DDE; Phenoxyacetic herbicides; 2,4-D; 2,4,5-T; Dithiocarbamates; maneb; zineb; methyl bromide; 1,1-dichloroethane | Agent Orange; cadmium; carbon monoxide; Dioxins/TCDD; manganese; methyl methacrylate; phosphine; Pyrethins/Pyrethroids; Solvents; benzene; methylene chloride; styrene; tetrachloroethylene (PCE); trichloroethane; trichloroethylene (TCE); toluene; xylene; tellurium; triethyltin | 51; 89; 98; 144; 202 | Elemental mercury and mercury vapor cause peripheral neuropathy, but organic mercury effects are not well understood. Hexacarbons: n-hexane and methyl n-butyl ketone cause "glue-sniffer" neuropathy. *Organophosphates cause a delayed neuropathy occurring 1-3 weeks after exposure. Compounds associated with this include chlorpyrifos, dichlorvos, ethyl 4-nitrophenyl phenylphosphonothionate, leptophos, methamidophos, mipafox, omethoate, parathion, tri-ortho-cresyl phosphate, trichlorofon, and trichloronat. DMAPN - used as a catalyst in the manufacture of polyurethane |
| Photosensitivity | Dermatology (Skin); Allergy | | acridine; Aminobenzoic acid derivatives; benomyl; Chromium; Coal tars; Halogenated salicylanilides; PAHs; Pesticides; Stibene (antimony) | | 11 | @ - hexavalent chromium compounds |
| Pleural disease (effusions, plaques, thickening) | Respiratory | asbestos; Ceramic fibers; Talc | mica | | 15 | |
| Pneumoconiosis | Respiratory | antimony; asbestos; Ceramic fibers; Talc | bentonite; iron; Metals*; tin | attapulgitic; barium; Cement; fluoride; PVC; wollastonite | 16; 20 | *Metal alloys found in dental labs containing chromium, cobalt, nickel, molybdenum, beryllium, and titanium. |
| Pneumonia | Respiratory | | beryllium; cadmium; manganese; mercury; nickel; nitrogen dioxide; tellurium; vanadium; zinc | Isocyanates; Pesticides; trimellitic anhydride; 1,1-dichloroethane | 89 | Pulmonary infiltrates have been demonstrated in pesticide applicators and after prolonged exposure to pesticides. |

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| Pneumonitis (hypersensitivity) | Respiratory; Allergy | beryllium; Isocyanates; Epoxy resins; Heavy metals; cadmium; Chromium; cobalt; mercury; nickel; zinc; Organic dusts*; Pyrethins/Pyrethroids; trimellitic anhydride | aluminum; arsenic; chlorine; manganese | | | *Organic dusts are contaminated with bacteria, fungi, amoebae, or animal proteins. |
| Polymer Fume Fever | Respiratory; Immunology | Teflon; polyvinyl fluoride; polytetrafluoroethylene | | | | Self-limited flu-like illness caused by degradation products formed by heating Teflon products to greater than 300 C |
| Porphyria (toxic) | Hematology (Blood); Liver | ethyl alcohol (ethanol); hexachlorobenzene; PAHs; PCBs | Dioxins/TCDD; halothane; lead; methyl chloride; Solvents; carbon tetrachloride; chloroform; Paint fumes; Paint fumes; formaldehyde; Pesticides; Organochlorine pesticides; chlordane; DDT/DDE; Organophosphates; diazinon; Phenoxyacetic herbicides; 2,4-D; 2,4,5-T; vinyl chloride | aluminum; Disinfectants; o-benzyl-p-chlorophenol; 2-benzyl-4,6-dichlorophenol | 47; 89 | Hexachlorobenzene exposure in adults results in cutaneous photosensitivity and porphyrinuria. However, in infants, exposure results in high mortality and neurotoxicity (convulsions) without porphyrinuria. Aluminum inhibits some heme synthetic enzymes and has been implicated in causing porphyria in chronic hemodialysis patients, whom are often aluminum overloaded. Lead intoxication causes signs and symptoms similar to acute intermittent porphyria including abdominal pain, constipation and vomiting. However, anemia which is often found with lead intoxication is virtually absent in porphyria. |
| Pre-eclampsia (pregnancy-induced hypertension) | Female Reproduction | | chloroform; Solvents | | 100 | |
| Pre-term delivery | Developmental; Pediatrics; Reproduction | Tobacco Smoke (Active smoking); Tobacco smoke (Secondhand) | Air pollution; carbon monoxide; Particulate air pollution (soot); benzene; DDT/DDE; DES; ethylene oxide; lead | carbon disulfide; Phenoxyacetic herbicides; Phthalates; di(2-ethylhexyl) phthalate (DEHP)/MEHP | 56; 58; 98; 106; 114; 136; 153; 166; 196 | |
| Prostate cancer | Oncology (cancer); Genito-Urinary; Male Reproduction | | Agent Orange; Aromatic amines; Solvents; PAHs; Pesticides; methyl bromide; Organochlorine pesticides | acrylonitrile; Androgens; Estrogens/DES; bisphenol A; cadmium; Chlorophenols; Chromium; Diesel exhaust; methylene chloride^; nickel; Pesticides; atrazine; dibromochloropropane (DBCP); dichlorvos; DDT/DDE; Phenoxyacetic herbicides; PhIP (2-amino-1-methyl-6-phenylimidazol(4,5-b)pyridine); trichloroethylene (TCE) | 29; 54; 64; 85; 98; 117; 129; 130; 156; 170; 202 | # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC) (IARC), Polymorphisms of genes for enzymes NAT-1, CYP2D6*B, and GSTT1 have been weakly associated with increased risks of prostate ca. Pesticide exposure in applicators, manufacturers, and farmers has been associated with prostate ca. In these studies, the individual was exposed to mixtures of pesticides that are unidentifiable from study designs. |
| Psychiatric disturbances (disorientation, hallucinations, psychosis, delirium, paranoias, anxiety/depression, emotional lability, mood changes, euphoria). | Neurology; Psychiatry | carbon disulfide; ethyl alcohol (ethanol); mercury; lead | ethylene oxide; manganese; trichloroethylene (TCE); Pesticides; methyl bromide; DDT/DDE; dichloropropene; Organophosphates; chlorpyrifos | acrylamide; Organochlorine pesticides; chlordecone; dicofol; dieldrin; telodrin; thallium | 58; 89; 98; 202 | |
| Pulmonary disease-anemia syndrome | Respiratory; Immunology | trimellitic anhydride | | | | Caused by repeated hi-dose exposure to TMA fumes. Coombs positive hemolytic anemia and respiratory failure are evident. |
| Pulmonary edema | Respiratory | hydrogen sulfide; paraquat; diquat; phosgene | ammonia; beryllium; ethylene oxide; formaldehyde; hydrofluoric acid; Nitrogen oxides; mercury; methyl bromide; Organophosphates; nickel; phosphine; tetrachloroethylene (PCE); Chloro-Phosphate compounds; Thioureas; zinc | aluminum; antimony; boron; cadmium; ozone; polytetrafluoroethylene; selenium; 1,1-dichloroethane | | |

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| Pulmonary fibrosis | Respiratory | aluminum; asbestos; Coal dust; silica; paraquat; Tobacco smoke | beryllium; Chromium; nickel; vinyl chloride | cadmium; copper; fluoride; gold; mercury; ozone; phosgene | 16 | |
| Raynaud's phenomenon | Cardio-vascular; Immunology | Vibration; vinyl chloride | arsenic; Nitrates/Nitrites | Estrogens/DES; tetrachloroethylene (PCE); trichloroethylene (TCE) | 23 | |
| Reduced Fertility - Female (infertility and subfertility) | Developmental; Female Reproduction; Genito-Urinary | Anesthetic gases; Ionizing radiation; Tobacco Smoke (Active smoking); Estrogens/DES | Ethylene glycol ethers; formaldehyde; lead; nitrous oxide; Pesticides; Solvents; tetrachloroethylene (PCE); toluene; Tobacco smoke (Secondhand); 1-bromopropane; 2-bromopropane | Dioxins/TCDD; mercury; Pesticides; Herbicides; hexachlorobenzene; Organochlorine pesticides; chlordane; DDT/DDE; PCBs; pentachlorophenol (PCP); styrene; vanadium | 42; 68; 98; 112; 124; 145; 185; 205; 208; 210; 211; 212; 213; 214; 215 | Women exposed to DDT in the womb have been shown to have reduced fertility (increased time to pregnancy) as adults. |
| Reduced Fertility - Male (infertility and subfertility) | Developmental; Genito-Urinary; Male Reproduction | carbon disulfide; Estrogens/DES; ethyl alcohol (ethanol); Ethylene glycol ethers; Heat; Ionizing radiation; lead; Pesticides; chlordane; dibromochloropropane (DBCP); ethylene dibromide (EDB); 1,1-dichloroethane; 2-bromopropane | cadmium; methylene chloride; Radar; tetrachloroethylene (PCE); Welding fumes; 1-bromopropane; Tobacco Smoke (Active smoking); Tobacco smoke (Secondhand) | methoxychlor; vinclozolin; dinoseb; bisphenol A; hexachlorobenzene; lindane; benomyl; Chromium; ethylene oxide; manganese; mercury; Solvents; Dinitrotoluenes; epichlorohydrin; toluene diamine; PAHs; benzo(a)pyrene; Pesticides; carbendazim; carbaryl; 2,4-D; DDT/DDE | 42; 53; 56; 80; 89; 98; 112; 202; 205; 208; 213; 216; 239 | Subpopulations of men with genetic polymorphisms in ion channel isoforms may be at a higher risk for sperm damage from heavy metal exposure. Exposure to pesticides in farming or pesticide application have been associated with reduced time to pregnancy. Studies have not identified particular pesticides or pesticide classes. |
| Renal (kidney) cancer | Genito-Urinary; Oncology (cancer); Renal (kidney) | Tobacco Smoke (Active smoking)+ | arsenic+; asbestos; benzene; Coal tars; Particulate air pollution (soot); Coal tars; Asphalt; Creosotes; copper sulfate; PAHs; pentachlorophenol (PCP); Pesticides; captan; trichloroethylene (TCE) | benzidine; cadmium; Chromium; p-dichlorobenzene; Gasoline; lead; mercury; Mineral oils; Cutting oils; Lubricating oils; MTBE; Mustard gas; nickel; Solvents; carbon tetrachloride; chloroform; tetrachloroethylene (PCE); Pesticides; Fungicides; captan; Chlorothalonil; dibromochloropropane (DBCP); glyphosate; nitrapyrin; potassium bromate; tetrafluoroethylene; vinyl chloride | 29; 62; 81; 86; 98; 126; 202 | + - Group 1 human carcinogen, # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC). Organic solvent and degreasing exposure in iron/steel and dry cleaning/laundry workers. Pesticide exposure associated with disease includes insecticide |
| Renal stones | Renal (kidney); Metabolism | beryllium; cadmium | | | | Cadmium exposure in cigarette smokers is double (see acute tubular necrosis comments). Up to 30% of berylliosis patients have renal stones. |
| Retinoblastoma | Oncology (cancer); Neurology; Pediatrics | | | Pesticides | 36 | Exposure to pesticides through farming in maternal grandparents was associated with retinoblastoma in one case-control study. |
| Rheumatoid arthritis | Immunology; Musculo-skeletal | silica | Tobacco smoke | Estrogens/DES; Pesticides; Solvents | 22; 23; 77; 94 | |
| Rhinitis - allergic | Respiratory; Immunology; Allergy | Acid anhydrides; amylase; Diisocyanates; Guar gum; Latex; Metal salts; platinum; nickel; vanadium; Chromium; cobalt; Organic dusts; trimellitic anhydride; Wood dust | Diesel exhaust | Phthalates | 166; 183 | Allergens causing allergic rhinitis also can cause sinusitis and occupational asthma. Numerous agents have been associated with rhinitis - a few are included here. Acid anhydrides are found in epoxy resins and paints. |
| Rhinitis - irritant | Respiratory; Immunology; Ear, Nose, and Throat | Air pollution; Diesel exhaust; nitrogen dioxide; ozone; sulfur dioxide; Aldehydes; ammonia; chlorine; phosgene; VOCs | | | | |
| Salivary gland cancer | Oncology (cancer); Ear, Nose, and Throat | Ionizing radiation | | | | |
| Sarcoidosis | Respiratory; Immunology | | silica | aluminum; barium; beryllium; cobalt; copper; gold; titanium; zirconium | | |

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| Scleroderma | Dermatology (Skin); Immunology | silica | Solvents; benzene; carbon tetrachloride; Paint thinners/removers; trichloroethane; trichloroethylene (TCE); toluene; xylene; vinyl chloride | Estrogens/DES; Epoxy resins; Herbicides; mercury; metapenylenediamine; naphtha; Silicone/Parafin breast implants; tetrachloroethylene (PCE); n-Hexane | 9; 23; 77 | Occupational silica exposure has been associated with the development of scleroderma in males but not females. The scleroderma-like syndrome caused by vinyl chloride has been shown to occur in groups with HLA-DR5, similar to patients with classic idiopathic scleroderma. A case of scleroderma has been reported after exposure to a herbicide containing a combination of bromobutyl methyl uracil, dichlorophenyl dimethylurea, and aminotriazole. |
| Scrotal cancer | Dermatology (Skin); Oncology (cancer); Genito-Urinary | Coal tars+; Shale oils+; PAHs | Creosotes# | | | + - Group 1 human carcinogen, # - Group 2A human carcinogen (IARC) |
| Seizures | Neurology; Developmental | carbon monoxide; cyanide; lead; mercury | aluminum; Halogenated hydrocarbons; Pesticides; methyl bromide; Organochlorine pesticides; Organophosphates; phosphine | beryllium; boron; hexachlorophene; Organotins; Solvents; Pyrethins/Pyrethroids | 58; 60; 89; 98 | |
| Silicosis | Respiratory | silica | | | | Silicosis is associate with an increased incidence of mycobacterial and/or fungal infections |
| Skeletal malformations* | Musculo-skeletal; Pediatrics; Birth defects | ethyl alcohol (ethanol) | arsenic | Ethylene glycol ethers; ethylene oxide; manganese; nicotine; Pesticides; atrazine; bromoxynil; chlordecone; molinate; 1,1-dichloroethane | 58; 68; 89; 202 | *Includes limb reduction, syndactyly, and polydactyly. Parental exposure to pesticides have been associated with a 3-4 fold risk of skeletal malformations. |
| Skin cancer (non-melanoma) | Dermatology (Skin); Oncology (cancer) | arsenic+; Coal tars+; Ionizing radiation+; Mineral oils+; Shale oils+; UV radiation+ | Aromatic amines; Creosotes#; ethylene oxide; PAHs; benz(a)anthracene#; benzo(a)pyrene#; dibenz(a,h)anthracene; dimethyl benzanthracene; methylcholanthrene; Pesticides; Arsenical pesticides | acrylamide#; vinyl chloride | 11; 98 | + - Group 1 human carcinogen, # - Group 2A human carcinogen (IARC), Skin cancer caused by chemical exposure can take 20-50 years to manifest. |
| Skin ulceration | Dermatology (Skin) | Acids/Alkalis; arsenic; beryllium; calcium arsenate ; calcium nitrate; Chromium; Lime; tin; zinc | | | | |
| Soft tissue sarcoma * | Oncology (cancer); Pediatrics | Dioxins/TCDD+ | Chlorophenols^; DDT/DDE^; Phenoxyacetic herbicides^; Agent Orange; 2,4-D; 2,4,5-T; MCPA; Chlorophenols^ | cadmium; Chromium; cobalt^; iron; nickel; Pesticides; amitrole; Fungicides; captafol; hexachlorobenzene^; Organochlorine pesticides; chlordane; lindane; titanium | 25; 26; 36; 84; 89; 98; 123; 187 | * Includes rhabdomyosarcoma, fibrosarcoma and other types of soft tissue sarcoma. '+ - Group 1 human carcinogen, ^ - Group 2B human carcinogen (IARC) Limited data have associated pesticide use with increased risk of STS in children. |
| Spasticity/Myoclonus | Musculo-skeletal; Neurology | mercury | aluminum; carbon monoxide; hexane; Pesticides; methyl bromide; Organochlorine pesticides; Organophosphates; 1,1-dichloroethane | bismuth | 60; 98 | |
| Steatosis (fatty liver) | Liver; Gastrointestinal | ethyl alcohol (ethanol); Solvents; carbon tetrachloride; chloroform; dimethylformamide; tetrachloroethane; trichloroethane; phosphorus | arsenic; halothane; Hydrazines; Hydrocarbons; styrene; TNT (Trinitrotoluene) | | 6; 47 | Arsenical pesticides have been associated with steatosis. Hydrocarbon exposure in petrochemical workers has been associated with non-alcoholic fatty liver disease. |
| Stomach cancer | Gastrointestinal; Oncology (cancer) | | asbestos; Aromatic amines; Chromium; Coal dust; Dioxins/TCDD; ethylene oxide; Ionizing radiation; nickel; Nitrates/Nitrites; Solvents; Phenoxyacetic herbicides; Trihalomethanes; Chlorination byproducts | acrylonitrile; 1,3-butadiene; lead#; PAHs; Pesticides; amitrole; Chlorothalonil; dibromochloropropane (DBCP)^; dichlorvos; dichloropropene; ethylene dibromide (EDB)#; propylene oxide; Solvents; toluene; xylene | 81; 98; 123; 198 | # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC) Pesticide exposure in applicators, manufacturers, farmers and other occupations with diverse exposures to mixtures of pesticides has been associated with stomach ca. In these studies it was not possible to associate the cancer with individual pesticide exposure. |

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| Sudden Infant Death Syndrome (SIDS) | Pediatrics; Respiratory | Tobacco smoke (Secondhand) | | | 147 | |
| Systemic Lupus Erythematosus | Immunology | silica | Estrogens/DES | Aromatic amines; DES; Hair dyes; Silicones; Tobacco smoke; trichloroethylene (TCE); UV radiation | 9; 22; 23; 77; 94 | |
| Testicular atrophy | Endocrine (Hormones); Genito-Urinary; Male Reproduction | Estrogens/DES; ethyl alcohol (ethanol) | | acrylamide; boron; 1,3-butadiene; Glycol ethers; 2-methoxyethanol; 2-ethoxyethanol; Pesticides; carbendazim; chlordane; dibromochloropropane (DBCP); dinoseb; ethylene dibromide (EDB); terrazole; Phthalates; benzyl butyl phthalate (BBP); dibutyl phthalate (DBP); di (2-ethylhexyl) phthalate (DEHP)/MEHP; triphenyltin; benomyl | 76; 98; 165 | |
| Testicular cancer | Oncology (cancer); Genito-Urinary; Male Reproduction | | Estrogens/DES+; Pesticides; chlordimeform/4-COT* | acrylamide; cadmium; Chlorophenols; dimethylformamide^; Electromagnetic fields; Ethylene glycol ethers; MTBE; Pesticides; dibromochloropropane (DBCP); Fungicides; hexachlorobenzene; hexaconazole; iprodione; Herbicides; 2,4-D; linuron; MCPA; pronamide; methyl bromide; Organochlorine pesticides; chlordane; methoxychlor; Organophosphates; PCBs; trichloroethylene (TCE); zinc | 29; 36; 68; 85; 87; 89; 98; 117; 126; 164 | ^ - Group 2B human carcinogen (IARC), *4-COT is the metabolite of chlordimeform. Pesticide exposure in applicators, manufacturers, farmers and other occupations with diverse exposures to mixtures of pesticides has been associated with testicular ca. In these studies, it was not possible to correlate an individual pesticide exposure with disease. Parental exposure to pesticides has also been associated with testicular ca. in male offspring. |
| Thrombocytopenia | Hematology (Blood); Immunology | benzene | gold; vinyl chloride | Pesticides; dichlorvos; DDT/DDE; dieldrin; Pyrethins/Pyrethroids; lindane; polyurethane; toluene diisocyanate; turpentine | 22 | |
| Thrombocytopenic purpura | Hematology (Blood); Pediatrics | | | Pesticides; lindane; permethrin; polyurethane; pentachlorophenol (PCP); tributyl tin oxide; Solvents; turpentine | 99 | |
| Thyroid cancer | Oncology (cancer); Metabolism; Endocrine (Hormones) | Ionizing radiation | ethylene thiourea (ETU)^ | acrylamide#; Chlorophenols; Nitrosamines; Polybrominated Diphenyl Ethers (PBDEs); Pesticides; amitrole; Fungicides; fenbuconazole; maneb; mancozeb; triadimefon; tycor; zineb; Herbicides; clofentezine; hexachlorobenzene^; pendimethalin; Phenoxyacetic herbicides; prodiamine; pronamide; thiazopyr; treflan; trifluralin; Dioxins/TCDD | 84; 89; 98 | # - Group 2A human carcinogen, ^ - Group 2B human carcinogen (IARC) Pesticide exposure in agricultural areas and in farmers with diverse exposures to mixtures of pesticides has been associated with thyroid cancer. In these studies, it was not possible to correlate an individual pesticide exposure with disease. |
| Thyroid disorders - Hypothyroidism | Metabolism; Endocrine (Hormones) | cobalt; Ionizing radiation; PBBs; PCBs; Radioactive iodine (I131); Phenols; thiocyanate | Dioxins/TCDD; ethylene thiourea (ETU); perchlorate; 1,1-dichloroethane | carbon disulfide; fluoride; lead; mercury; Pesticides; Carbamates; Fungicides; hexachlorobenzene; maneb; zineb; Organochlorine pesticides; Organophosphates; pentachlorophenol (PCP); Polybrominated Diphenyl Ethers (PBDEs) | 80; 93; 101; 137; 143 | |
| Toxic oil syndrome | Immunology | | Oleyl-anilide | | | 9 Epidemic in Madrid, 1981, caused by rapeseed (canola) oil denatured with 2% aniline and sold illegally for food use. 2.3% mortality rate with symptoms resembling a connective tissue disease including vasculitis, scleroderma-like skin disease, eosinophilia, high IgE and low levels of autoantibodies. HLA DR3-DR4 were associated with chronic disease. Etiology and syndrome are very similar to eosinophilic-myalgia syndrome. |
| Trigeminal neuropathy | Neurology | | dichloroacetylene; trichloroethylene (TCE) | | | |
| Undifferentiated Connective Tissue Disease | Immunology | | Solvents | | 10; 77 | Solvents exposure from paint thinners or removers and the use of mineral spirits have been associated with UCTD. |
| Uterine cancer | Oncology (cancer); Genito-Urinary; Female Reproduction | Estrogens/DES+/DES+; 1,1-dichloroethane | | acrylamide; arsenic; ethylene oxide; Pesticides; captafol; daminozide (Alar); DDT/DDE; dieldrin; Progestins^ | 30; 131; 164; 168 | |
| Uterine fibroids | Female Reproduction; Genito-Urinary; Reproduction | | | DES | | |

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|----------------|--|------|--------|-------------------------------------|--------|--|
| Vaginal cancer | Oncology (cancer); Genito-Urinary; Female Reproduction | DES+ | | | | |
| Vasculitis | Cardio-vascular; Immunology | | silica | Solvents; Pesticides; Welding fumes | 77; 97 | Includes primary systemic vasculitis, Wegener's granulomatosis, microscopic polyangitis, Churg-Strauss syndrome. Occupations such as farming and agricultural work have been associated with vasculitis. |
| Wilm's Tumor | Renal (kidney); Oncology (cancer); Pediatrics | | | Aromatic amines; lead; Pesticides | 35; 36 | Parental occupational exposure has been associated with childhood Wilm's tumor. |

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