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 of 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
					See references at end of document	
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	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	

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.

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 sulfer 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.

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	Berryliosis 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.

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 exposu
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. Dieacetyl 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	

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	Ophthomology (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)

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 disabiling 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; Ophthomology (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.

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; Ophthomology (Eye); Developmental	carbon monoxide; methanol	carbon disulfide; copper; Fungicides; methyl bromide; mercury; n-Hexane; Organotins	methylenedianiline; osmium tetraoxide; 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; 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	

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.

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; oxyfluorofen; Phenoxyacetic herbicides; pronamide; quizalofop-ethyl; triallate; metam sodium; Organochlorine pesticides; aldrin; chlorbenzilate; 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.

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 hs 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; Organotins; 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 immunosuppresive 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

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	Ophthomology (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; chlordecone; 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,

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; Musculo-skeletal; 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		

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	

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 trichlornat. 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	attapulgite; barium; Cement; fluoride; PVC; wollastonite	16; 20	*Metal alloys found in dental labs containing chromium, cobalt, nickel, molybdenum, berryllium, 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.

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 laibility, 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		

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; chlordecone; 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; chlordecone; 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; captafol#; 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		

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; metaphenylenediamine; 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.

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; chlordecone; 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		

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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