

# A Small Dose of Toxics in the Home Or An Introduction To Toxics In The Home

A book chapter of  
*A Small Dose of Toxicology - The Health Effects of Common Chemicals*

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Supporting web sites  
web: [www.asmalldoseof.org](http://www.asmalldoseof.org) - "A Small Dose of Toxicology"  
web: [www.toxipedia.org](http://www.toxipedia.org) - Connecting Science and People

## Dossier

<p><b>Name:</b> Toxics at Home</p> <p><b>Use:</b> Various uses in household products (medicines, pesticides, cleaning agents, paint, mercury thermometers, plastics)</p> <p><b>Source:</b> Naturally occurring (mold, radon) and purchased household products</p> <p><b>Recommended daily intake:</b> usually not recommended</p> <p><b>Absorption:</b> skin, oral, inhalation</p> <p><b>Sensitive individuals:</b> children (account for majority of poisoning incidents around the home)</p> <p><b>Toxicity/symptoms:</b> varies greatly (acute and long-term effects)</p> <p><b>Regulatory facts:</b> EPA, FDA, Consumer Product Safety Commission</p> <p><b>General facts:</b> Many home products are necessary, but often less toxic alternatives are available</p> <p><b>Environmental:</b> serious environmental concern (i.e. mercury, detergents)</p> <p><b>Recommendations:</b> use less toxic alternatives, dispose of hazardous wastes properly</p>
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## Introduction

The home is a complex environment that contains many hazards and toxic materials, some naturally occurring and many others that we bring into the home. A common naturally occurring hazard is radon, a radioactive material that is released from the soil and bedrock. In a humid environment, mold and mildew can grow, releasing spores and toxins into the indoor air. Dust mites, invisible to the human eye, roam our home and in the right circumstances cause health problems. Some of the greatest hazards are from what we bring into the home.

The toxicology of household products is fascinating because it deals with products that we are all familiar with and because so many different kinds of products are involved. A typical home may contain cleaning products, cosmetics and personal care products, paints, medications, pesticides, fuels, and various solvents. Thermometers and thermostats may contain mercury a well-known neurotoxicant. Older homes were often painted with a lead-based paint which when consumed causes serious developmental effects. Building materials may contain toxic solvents that are released into the home. The toxicity and ingredients of household products vary widely, but highly toxic products are found in most homes.

Table 18.1 Toxics in the Home

<b>Toxics in the Home</b>
<ul style="list-style-type: none"><li>• Radon</li><li>• Lead in paint</li><li>• Indoor air pollutants</li><li>• Second-hand smoke</li><li>• Mold &amp; mildew</li><li>• Household hazardous waste</li><li>• Dust from inside and tracked in from outside</li><li>• Consumer products, e.g. old foam mattresses or cushions</li><li>• Household products<ul style="list-style-type: none"><li>○ Cleaning products, cosmetics and personal care products, paints, medications, pesticides, fuels, and various solvents, mercury-based thermometers</li></ul></li></ul>

Both the general environment and individuals in the home can suffer the consequences of the products used in and around the home. Many household products contain chemicals that when used contaminate our air and water. Consumers in the United States use about 8.3 billion pounds of dry laundry detergent and about a billion gallons of liquid detergent per year. Some of these laundry and dishwashing detergents contain phosphate. High phosphate levels in water encourage the growth of algae, which can suffocate other marine life. Mercury from broken thermometers can harm the individual but also moves into the atmosphere, into surface waters and ultimately into the fish we eat. Paints, varnishes, motor oil, pesticides, antifreeze, and fluorescent lights are clearly hazardous wastes that when improperly disposed of harm the environment. Consumers in the United States generate 1.6 million tons of household hazardous waste each year. How many pounds of hazardous waste do you have in your home?

Many countries and regions have poison centers that provide information for people exposed to toxic substances. It is estimated that there are over 17,000 chemicals found in homes, many with only limited toxicity information. The centers maintain large databases on products and substances as well as the appropriate response following exposure. Every day there are many household exposure incidents, some resulting in immediate and serious consequences (see below). By far the most vulnerable population is children. In the United States more than 50% of the poisoning incidents involve children less than six years of age. The poison centers primarily focus on acute or immediate response to an incident. The poison centers also handle information and animal poisoning related calls.

## Poisoning events in United States - 2007

- 2.5 million reported exposures
- 1.6 million information calls
- 51% involved children under age 6
- 93% occurred in the home
- 423,290 treated in a health care facility
- 1,597 deaths reported in 2007

Source: National Poison Centers, 2007 data (Bronstein et al, 2008)

Exposure to hazardous substances in the home can also have long-term health implications. Children and the elderly spend a great amount of time in the home, increasing their exposure to any toxic substances found there. Over 15 million people in the United States suffer from asthma, including 5 million children. The number of children with asthma continues to increase despite ongoing research into the possible causes. The causes may include household dust, droppings from dust mites and mold. Asthma-related illness result in over 100,000 children visiting a hospital and losing over 10 million school days per year. A very different kind of long-term disability results from childhood lead exposure. The U.S. Centers for Disease Control and Prevention estimated that over one million U.S. children have elevated blood lead levels due to household exposures.

## Exposure

### Routes of Exposure

Residents can be exposed to household products by accidental ingestion, skin contact, splashing into the eyes, and by inhalation of vapors or airborne particles. Exposures can be short-term, resulting from a single product use or spill, to long-term, from frequent product use or off gassing of volatile components.

### **Ingestion**

**Direct ingestion of product  
Hand to mouth contact**

### **Inhalation**

**Acute inhalation of product during use  
Chronic inhalation of indoor air**

### **Skin/eye contact**

**Splashing/spilling during use  
Violent chemical reactions  
Contact with treated surfaces**

## **Acute Exposures**

In the year 2009, poison centers in the United States responded to nearly 2.5 million incidents, mostly home exposures to chemical products, animal bites, and poisonous plants. Over 50% percent involved children under the age of six. In all, Over 25,000 incidents resulted in medical outcomes deemed “major”, and there were 1,544 deaths. Almost half stemmed from exposure to pharmaceutical products. Of the remaining exposures, the largest groups resulted from cosmetics and personal care products and household cleaners. Although the large number of incidents says more about the ubiquity of potentially hazardous products in the home than about their toxicity, the numbers also point out the extent of the potential dangers if products are toxic or if medical aid is not rapidly received. Many more deaths and serious injuries would occur if not for the rapid intervention of poison centers.

Several groups of household products can have serious and rapid acute health impacts:

**Corrosives:** Strong acids, bases, or oxidizers can cause permanent eye damage, skin burns, and, if swallowed, sever gastrointestinal damage. Examples of corrosive products include alkaline drain cleaners and oven cleaners, acid-based toilet bowl cleaners and rust removers, concentrated disinfectants, and some concentrated pesticides, especially fungicides.

**Solvents:** Products with a high percentage of solvents, such as oil-based paints, paint removers, fuels, lighter fluids, furniture polishes, and some pesticides can cause potentially fatal pneumonia if aspirated into the lungs as a result of accidental ingestion.

If used in an unventilated space, they can also cause symptoms of acute intoxication, including dizziness, nausea, and in some cases nerve damage or other effects.

Medications: Useful as prescribed, many medications are toxic and can be very dangerous if taken by someone other than the intended patient, especially a child, or if taken in too high a dose.

Pesticides: Although many household pesticides are rather dilute, some are concentrated enough to be acutely toxic. They include concentrates of insecticides, fungicides, and some herbicides.

## **Chronic Exposures/Chronic Effects**

Chronic, or long-term exposures can occur through repeated use of a product or through contact with long-lasting residues in the air, soil, household surfaces, or dust. EPA's TEAM (Total Exposure Assessment Methodology) studies found that levels of a dozen volatile organic compounds were two to five times higher indoors than outdoors, regardless of the geographic location of the home. When volatile products are used indoors, levels of chemicals in the air can exceed background by 1000 times or more and persist for a long time. Contaminated soil can be a major source of exposure, especially for children who play in it or mouth their hands. In addition to isolated, elevated levels of contaminants from industrial sources, studies show consistently elevated levels of lead near the foundation of homes once painted with lead-based paint. Wooden decks built from treated lumber containing arsenic typically contaminate the soil beneath to levels far above background. Lead and other contaminants are tracked into the home on shoes, where they are stored in house dust. Carpets can contain large reservoirs of dust that eludes all but the most diligent vacuuming. House dust also can contain elevated levels of pesticides, combustion soot, nicotine, and allergens.

Products containing volatile ingredients such as solvents cause a general decline in indoor air quality when used inside the home. Volatile solvents often found in household products include those shown in the table below. The last column shows permissible air concentrations of these solvents in occupational settings. The higher the number is, the less toxic the material.

### **Volatile Toxic Chemicals**

Table 18.2 Volatile Toxic Chemicals

Ingredient	Product	Occupational Exposure Limits (ppm)
Ethanol	Alcoholic beverages	1000
Acetone	Nail polish remover	750
Ethyl acetate	Nail polish remover, marker pens	400
Isopropanol	Rubbing alcohol, personal care products	400

Gasoline	Motor fuel	300
Methanol	Paint remover	200
Turpentine	Paint thinner	100
Xylene	Spray paint, market pens, adhesives	100
Hexane	Adhesives	50
Methylene chloride	Paint remover	50
Toluene	Paint remover, spray paints	50
Carbon monoxide	Auto exhaust, burning charcoal	10
Naphthalene	Mothballs	10
Paradichlorobenzene	Mothballs	10
Formaldehyde	Particle board, plywood	0.30
Chlorpyrifos	Insecticide*	0.014

\* Chlorpyrifos was discontinued in U.S. for household use after the end of 2001.

Certain household products contain ingredients that can cause long-term or delayed chronic health effects such as cancer, reproductive effects, nervous system effects, and developmental effects. The table below lists some examples of types of products, ingredients, and the health effects that overexposure may lead to.

### **Chronic Health Effects**

Table 18.3 Chronic Health Effects

Ingredient	Found in*	Cancer	Reproductive	Developmental	Nervous
Chlorothalonil	Fungicide	X			
Triforine	Fungicide			X	
Carbaryl	Insecticide	X			X
Arsenic	Treated wood	X			X
Lindane	Lice treatment	X			X
Paradichlorobenzene (PDCB) or naphthalene	Mothballs	X			
Hexane	Adhesive				X
Lead	Hair dye, toys, paint	X	X	X	X
Benzene	Gasoline	X		X	
Aspirin	Pain relievers		X	X	
Ethyl alcohol	Beverages			X	X
Methylene	Paint				

chloride	remover	X			X
Polybrominated diphenyl ethers or (PBDE)	Mattresses, cushions, plastics		X	X	X
Bisphenol A (BPA)	Baby bottles, can liners,		X	X	X

\* Potential for listed ingredient to be found in product or category varies depending on product formulations.

## Risk

One of the greatest difficulties in estimating the toxicity of household products is the fact that most of the ingredients are not disclosed on product labels or other documents.

Household pesticides, for example, often contain well over 90% so-called “inert ingredients”, more recently referred to as “other” ingredients. The terminology relates to their function in the product rather than their toxicological characteristics, and these ingredients, with few exceptions, are not listed on product labels. Although product labeling regulations in the United States do allow one to deduce certain acute toxicity characteristics from careful reading of required label warnings, the conclusions one can draw are limited. Frequently, the Material Safety Data Sheet (MSDS), a document required by the U. S. Occupational Safety and Health Administration, contains LD50 or other toxicity data. Unfortunately, many MSDSs contain incomplete and apparently inaccurate information, making them a flawed tool for toxicity assessment. In other countries, labels are quite different, and even less information may be available.

The risk of adverse effects from exposure to household products is difficult to estimate because of the wide variety of products available, the many ingredients they contain, the presence of many “trade-secret” ingredients, and the wide variety of exposure scenarios. It is worth noting that the highest exposures to household products are typically to those most likely to be particularly susceptible: children, the elderly, and the chronically ill. These groups tend to spend on average more time in the home than adults aged 20 to 60, who are more likely to work outside the home and to be in good health. Children also exhibit behaviors that increase their exposure to toxic agents in the home: they play on the floor, they put their hands in their mouth, and they are curious about their surroundings. Combined with their low body weight, proportionately higher intake of food and water, and their developmental stage, these behavioral factors contribute to elevated risks.

Risks are undoubtedly increased when products are not used as directed. Examples might include using concentrates at full strength, mixing products with incompatible chemicals, using with inadequate ventilation, or deliberately inhaling solvents to get high. Reasons for “misusing” products are many:

1. Label too difficult to read (e.g. too small, not in native language, poorly written)
2. Consumer doesn't bother to read label
3. Directions too difficult or inconvenient (what is "adequate" ventilation?)

Nevertheless, even when used as directed, some products may cause significant health risks. Estimates of health risks are often controversial because they involve various assumptions about exposure that are difficult to measure and because the risk assessor may have a financial stake in the outcome. There are many examples of consumer products that have been banned or taken off of the market because of unacceptable health or environmental risks: the pesticides chlorpyrifos and diazinon, DDT; the wood preservatives pentachlorophenol and creosote; arsenic-treated lumber; carbon tetrachloride; and lead-based paint. Since the risk of using these products didn't change on the day they were taken off the market, one can infer that the products were unsafe before removal. More recently, extensive testing has turned up lead in many children's' toys. Brominated flame retardants (polybrominated diphenyl ethers or PBDE) are used in foam rubber and plastics, where they end up in house dust. In addition, Bisphenol A, an endocrine disruptor, is used in baby bottles and food-can liners. Given the huge number of consumer products on the market and entering the market every year, regulatory agencies will typically be delayed in identifying unsafe products.

## Risk Reduction

The risk from using household products can be reduced by reducing the hazard level (toxicity), by reducing exposure, or both. Reducing the toxicity—choosing less-toxic products—is arguably the best strategy because safer product choices can do more than reduce risk in the home. Safer products may also use fewer toxic chemicals in their manufacture and may be safer for the environment when disposed of.

When no safer alternatives are available, reducing exposure becomes especially important. Usually, product labels will explain the recommended safety equipment and procedures appropriate for a particular product. In addition to safety gear, ventilation, and mixing precautions, labels may also mention storage requirements. Unfortunately, some label directions are not specific enough to guarantee that following them will guarantee safe use.

Label-directed or common sense precautions should always be taken, even when using relatively low-toxicity products. For example, all chemical products should be kept out of children's reach.

Innovative programs are also available to help home residence reduce exposure to toxic substances. The Master Home Environmentalist™ program of the American Lung Association trains volunteers to visit home and contact a Home Environmental Assessment. Home residents are encouraged to make changes to reduce exposures to toxic substances. A major focus of this program is on reducing asthma in children.

## Safer Alternatives

Avoiding the use of toxic products can take the form of avoiding chemical products altogether for certain jobs, choosing products made from safer ingredients, and buying ready-to-use dilutions rather than concentrates. The table below shows some examples of less-toxic alternatives for common products.

### **Less-toxic Alternatives**

Table 17.4 Least-Toxic Alternatives

Alternative	Instead of Using	Toxic Ingredient Avoided
Latex paint	Oil-based paint	Solvents
Snake, plunger	Caustic drain opener	Corrosive lye
Scouring powder	Acid toilet cleaner	Corrosive hydrochloric acid
Beneficial nematodes	Insecticide for soil grubs	Diazinon, carbaryl or other insecticide
Weed puller, mulch	Herbicide	2,4-D, dichlobenil, etc.

A few additional words are necessary regarding alternatives to pesticides. Pest control is a complex process involving living organisms that can often be difficult to control using a single method. Integrated Pest Management (IPM) is a decision making process that utilizes preventative strategies, careful monitoring, realistic pest tolerances, and natural enemies to reduce the need for chemical pesticides. Although chemical pesticides may be used in IPM, a good IPM program typically reduces chemical use considerably and attempts to use only those chemicals that will minimize human and environmental impacts. Household pest control can follow the same strategies, using non-chemical methods whenever possible and choosing lower-impact pesticides if chemicals are necessary.

### **Recommendations**

Although the risks of household products are difficult to estimate, taking common-sense precautions can easily reduce them:

1. Minimize purchase of toxic or otherwise hazardous products.
2. Store all chemical products out of children's reach.
3. Read and follow label directions.
4. Dispose of hazardous products in accordance with local regulations.

It is difficult for consumers to identify least-toxic products by comparing product labels. Government agencies could do much more to assist and protect consumers:

1. Government agencies should require that all product ingredients be listed on product labels. This practice would allow product users to better understand product hazards and to avoid ingredients they are allergic to or don't wish to purchase.
2. Government agencies in the United States that regulate product labels should harmonize their labeling systems to avoid inconsistencies between products that are regulated by different agencies.
3. Ultimately a more precautionary approach needs to be adapted to protect human and environmental health.

## **More Information and References**

### **Slide Presentation**

A Small Dose of Toxics at Home presentation material and references online:  
<http://www.toxipedia.org> with more details and specific information including a PowerPoint presentation at  
<http://www.toxipedia.org/display/dose/Toxics+in+the+Home>,

Web site contains presentation material related toxics in the home.

### **European, Asian, and International Agencies**

- England – Department of Health – Healthy Schools. Online: <<http://www.healthyschools.gov.uk/>> (accessed: 16 August 2009).  
Healthy Schools, while focusing on schools is wonderful site with information of students, parents, and teachers on creating a healthy in door environment.
- World Health Organization – Child Health. Online:  
<[http://www.who.int/health\\_topics/child\\_health/en/](http://www.who.int/health_topics/child_health/en/)> (accessed: 16 August 2009).  
Site has information on global child health issues.

### **North American Agencies**

- U.S. Household Products Database – National Institutes of Health, National Library of Medicine. Online: <<http://householdproducts.nlm.nih.gov/index.htm>> (accessed: 16 August 2009).  
Site has a range of information about household products including their potential health threats.
- U.S. Environmental Protection Agency - Household Waste Management. Online:  
<<http://www.epa.gov/seahome/hwaste.html>> (accessed: 16 August 2009).  
Site has a self-directed educational program on managing household waste.

U.S. Environmental Protection Agency – Household Hazardous Waste. Online: <<http://www.epa.gov/epawaste/conserve/materials/hhw.htm>> (accessed: 16 August 2009).

Site has general information on household hazardous waste.

- U.S. Environmental Protection Agency - Office of Pollution Prevention & Toxics (OPPT). Online: <<http://www.epa.gov/opptintr/>> (accessed: 16 August 2009).  
The site promotes safer chemicals and risk education.
- U.S. Environmental Protection Agency – Indoor Air Quality (IAQ). Online: <<http://www.epa.gov/iaq/>> (accessed: 16 August 2009).  
This site contains information on indoor air and related health issues.
- California – Office of Environmental Health Hazard Assessment – Education – Art Hazards Program. Online: <<http://www.oehha.org/education/art/>> (accessed: 16 August 2009).  
Site has information on hazards art supplies and substitutes.

### **Non-Government Organizations**

- American Lung Association of Washington (ALAW). Online: <<http://www.alaw.org/>> (accessed: 16 August 2009).  
Site has information on childhood asthma and the Master Home Environmentalist Program.
- American Association of Poison Control Centers (AAPCC). Online: <<http://www.aapcc.org/>> (accessed: 16 August 2009).  
“AAPCC is a nationwide organization of poison centers and interested individuals.”
- California Poison Control System (CPCS). Online: <<http://www.calpoison.org/>> (accessed: 16 August 2009).  
Site has wide range of information on poisons in and around the home.
- Environmental Working Group (EWG). Online: <<http://www.ewg.org/>> (accessed: 16 August 2009).  
This organization provides information on a range of consumer products including data bases on sunscreens and cosmetics.
- Center for Health, Environment and Justice - Child Proofing our Communities Campaign. Online: <<http://www.childproofing.org>> (accessed: 16 August 2009).  
Site is “geared to protect children from exposures to environmental health hazards.”
- Washington Toxics Coalition (WTC). Online: <[www.watoxics.org](http://www.watoxics.org)> (accessed: 16 August 2009).

WTC provides information on model pesticide policies, alternatives to home pesticides, information on persistent chemical pollutants, data bases on toxic free toys, and much more.

- Washington State, Seattle – Environment. Online: <<http://www.cityofseattle.net/environment/>> (accessed: 16 August 2009). Site covers information on encouraging a sustainable environment including purchasing less toxic products.
- Green Seal. Online: <<http://www.greenseal.org/>> (accessed: 16 August 2009). Green Seal encourages the purchasing of products and services that cause less toxic pollution and waste.
- Washington State, King County – Household Hazardous Waste. Online: <<http://www.metrokc.gov/hazwaste/house/>> (accessed: 16 August 2009). Site contains information on managing and disposing of household hazardous products and waste.
  - Women's Voices for the Earth. Online: <<http://www.womenandenvironment.org/>> (accessed: 16 August 2009). WVE has information on green clean products and household hazards.
  - Clean Production Action - Sick of Dust Chemicals in Common Products. Online: <<http://cleanproduction.org/library/Dust%20Report.pdf>> (accessed: 16 August 2009). CPA's report on chemicals in dust and other green products.

## **References**

A Guide to Health Risk Assessment. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment. Available as a pdf file. Online.: <<http://www.oehha.org/risk/layperson/index.html>> (accessed: 16 August 2009).

Bronstein, A.C., Spyker, D.A., Cantilena, L.R. JR, Green, J.L., Rumack, B.H., Stuart E. Heard, S.E. 2007 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 25th Annual Report . Clinical Toxicology, 46:10, 927-1057 Available online: <http://dx.doi.org/10.1080/15563650802559632>

Ott, Wayne R., and John Roberts. Everyday Exposure to Toxic Pollutants; Scientific American, February 1998.

Steinemann, Anne C. Fragranced consumer products and undisclosed ingredients. Environmental Impact Assessment Review. 29(1), 2009, 32-38.