Cleaning Supplies and Your Health

Environmental Working Group's investigation of more than 2,000 cleaning supplies on the American market has found that many contain substances linked to serious health problems. EWG concludes that:

- Fumes from some cleaning products may induce asthma in otherwise healthy individuals. A large and growing body of evidence links frequent use of many ordinary cleaning supplies at home or on the job with development of asthma and other respiratory problems. It is already known that cleaning product fumes may trigger attacks in persons previously diagnosed with asthma.
- Common cleaning ingredients can be laced with the carcinogenic impurity 1,4-dioxane. Independent tests have detected the presence of 1,4-dioxane in numerous name-brand cleaning supplies. Other products contain preservatives that release low levels of cancer-causing formaldehyde.
- Children born to women who held cleaning jobs while pregnant have an elevated risk of birth defects, according to a 2010 study by the New York State Department of Health.
- Some cleaners can cause chemical burns and poisonings as well as less severe irritations and allergies. Severe physical reactions signal that consumers should take care anytime they use these products.
- Despite these health concerns, cleaning product labels often do not give consumers enough information about their ingredients to allow people to make informed decisions on which ones are safer and which ones might harm their health.

Government agencies and independent research institutions have not adequately evaluated the safety of numerous substances found in cleaning products. Although government scientific and regulatory agencies have focused considerable attention on chemicals suspected of causing cancer, they have devoted far fewer resources to evaluating substances that may be toxic to the brain and nervous system, the hormone system and other organs. Investigating the full range of risks of cleaning products to public health and the environment should be an urgent priority. Yet the problem remains largely hidden from the view of the American consumer.

Inadequate assessment of the long-term health consequences of chronic exposure to potent chemicals in cleaning products stems in large part from the absence of federal regulations requiring safety tests and setting legally-binding upper limits on toxic ingredients and impurities. The Consumer Product Safety Commission is nominally responsible for overseeing dangerous cleaning products but has focused on child-safe packaging and other measures to prevent accidents.

Sound chemical policy is critical to identifying and removing from commerce harmful chemicals in everyday products like cleaning supplies. In the meantime, the EWG's Guide to Healthy Cleaning can be a valuable tool in helping consumers to reduce their exposures to products known to contain harmful ingredients.

Learn more about cleaners and:

- Asthma
  - Asthmagens
- Cancer
- Reproductive and Developmental Toxicity

- Allergies and Irritation
- Accidents: Burns and Poisonings

Cleaning Products and Asthma

People with asthma can be exceptionally sensitive to air contaminants, including those in ordinary cleaning products. A 2009 study led by Jonathan Bernstein, a physician and leading asthma and allergy researcher at the University of Cincinnati College of Medicine, measured worsening symptoms in asthmatic women after they had completed housecleaning tasks (Bernstein 2009).

A growing body of evidence suggests that using cleaning products can also cause asthma to develop in healthy people. A 10-country study of more than 3,500 individuals who were initially free of asthma found that nine years later, those who used spray cleaners at least once a week to clean their homes had a 30-to-50 percent increased risk of developing asthma during the study period (Zock 2007). This association was linked primarily to commonly used spray products such as air fresheners, glass cleaners and furniture cleaning sprays. The risk increased the more often people used sprays or the greater the number of different sprays used.

The research team calculated that with the widespread use of spray cleaners and the high level of asthma risk, one in seven cases of adult asthma could be attributed to the use of these products (Zock 2007).

Preliminary findings also suggest that fetal exposure to household cleaning supplies may affect respiratory health. In a series of studies on parents and children, scientists at three British universities determined that children born to women who frequently used cleaning supplies in their homes while pregnant had a higher risk of persistent wheezing and reduced lung function (Sherriff 2005; Henderson 2008). The increased risk of these respiratory symptoms persisted for at least eight years after in utero exposure and was independent of many other indoor air pollutant exposures and potential confounding factors.

Asthmagens or Respiratory Irritants

Asthmagens: ingredients that can cause or worsen asthma

- *2-Bromo-2-Nitropropane-1,3-Diol
- Alkyl Dimethyl Benzyl Ammonium Chloride
- Alkyl Dimethyl Ethylbenzyl Ammonium Chloride
- Didecyldimethylammonium Chloride
- Diethanolamine
- Dioctyl Dimethyl Ammonium Chloride
- Distearyldimonium Chloride

Asthma: A Too Common Epidemic

In an asthma attack, the smooth muscles that line the airways to the lungs suddenly become swollen and inflamed and tighten up, obstructing or blocking the flow of air and causing chest tightness, wheezing, breathlessness and coughing. In people with the disorder, various circumstances can trigger an attack, including exposures to irritating or allergy-causing chemicals, stress or exercise.

This chronic disorder has become increasingly common in recent decades for reasons that remain unclear. According to the U.S. Centers for Disease Control and Prevention, overall asthma prevalence in the United States increased from 7.3 percent to 8.4 percent from 2001 to 2010, with even higher prevalence among children.

Scientists and doctors believe that asthma may be caused by a combination of environmental and hereditary factors. Various health organizations and government agencies have been investigating the association of the disorder with the inhalation of certain chemicals, often in occupational settings. Authoritative bodies such as the Association of Occupational and Environmental Clinics have compiled lists of chemicals, known as asthmagens, that have been reported to cause asthma.

EWG's assessment of more than 2,000 cleaning products found that 438 contain at least one chemical that the AOEC has identified as an asthmagen.

- *DMDM Hydantoin
- Ethanolamine
- Formaldehyde
- Glutaral
- Monoethanolamine Citrate
- Quaternium-15
- Quaternium-24
- Sodium Hypochlorite (Bleach)
- Sulfuric Acid
- Triethanolamine

* While not asthmagens themselves, these ingredients release formaldehyde, which is a recognized asthmagen.

Worker studies highlight asthma risk

Extensive studies show clear links between on-the-job exposure to cleaning supplies and the development of asthma in workers who had never shown previous signs of the disease (Medina-Ramon 2005, 2006; Rosenman 2006; Arif 2009; Quirce 2010; Zock 2010). Building custodians, teachers and health care workers are commonly exposed to cleaning supplies and are particularly afflicted by work-related asthma (Zock 2001; NIOSH 2004; Medina-Ramon 2005; Jaakkola 2006; Kogevinas 2007; Mazurek 2008). Many individuals recently diagnosed with asthma make a direct connection between exposure to certain cleaning products or chemicals and their condition. Studies have linked new cases of asthma to use of or exposure to spray cleaners, chlorine bleach sprays, disinfectants, air fresheners, drain cleaners, oven cleaners, furniture polish, carpet cleaners and floor waxing and stripping products (Nielsen 1999; Zock 2001, 2010; Medina-Ramon 2006; Obadia 2009; Quirce 2010; CDPH 2012).

A 2003 study led by Kenneth D. Rosenman, a professor of medicine at Michigan State University, found that 12 percent of the work-related asthma cases in four states were associated with exposure to cleaning products (Rosenman 2003). Four-fifths of the workers reporting work-related asthma linked to cleaning supplies had never suffered from the condition previously. Twenty-two percent of those afflicted worked as building custodians. In addition, seven of nine extensive epidemiological studies from several nations found an increased risk of asthma for people working as cleaners, with rates of asthma and asthma-type respiratory symptoms 1.5-to-2.5 times higher than in the general population (Rosenman 2006).

Chemicals can cause or worsen asthma

Several ingredients that are common in cleaning supplies are classified as asthmagens, meaning that they can cause asthma to develop in otherwise healthy people. In 2009, an EWG evaluation of 21 common school cleaners found that six of them emitted at least one of three common asthmagens into the air – formaldehyde, methyl methacrylate and styrene – when they were used as directed.

Many types of industrial chemicals can cause asthma. Those of greatest concern in cleaners include:

- Quaternary ammonium compounds, or “quats,” such as benzalkonium chloride, added as germ killers in antibacterial cleaning supplies and disinfecting air fresheners; they are also used as fabric softeners;
- Ethanolamines (mono-, di- and triethanolamine), commonly used to control product acidity (pH); they also act as detergents in many classes of cleaning products;
- Bleach (sodium hypochlorite) and ammonia (ammonium hydroxide), perhaps the most widely recognized cleaning ingredients in the world (AOEC 2012).

Many harsh acidic (low pH) or basic (high pH) cleaners aggravate asthma symptoms because they irritate the lungs. Moreover, if improperly mixed, bleach and acidic or ammonia-based cleaners can react to form extremely

high concentrations of chlorine gas, which can cause a person to develop asthma after a single intense exposure (AOEC 2012). Other chemicals, like quats, bleach and ammonia, can cause asthma through allergic reactions that develop slowly after frequent, long-term exposures to lower concentrations of the substances (Bernstein 2006; AOEC 2012).

Impurities and chemical reactions

Many ingredients in cleaning products evaporate easily, and some can react with other contaminants in the air to produce new, asthma-inducing chemicals. Some of these volatile organic compounds, or VOCs, have been measured at levels up to 100 times higher than those found outdoors and can exceed safety limits established for industrial facilities (Nazaroff 2006; EWG 2009; Bello 2010).

Airborne reactions involving volatile organic compounds can produce ozone, a powerful lung irritant. Long-term exposure to ozone during childhood can cause permanent lung damage (Kunzli 1997; Gilliland 2001). While there is little conclusive evidence that ozone alone can cause asthma, the subject merits more extensive study.

Pine- and citrus-based cleaners contain a class of volatile chemicals known as terpenes, which indirectly increase asthma risks. Terpenes may also be found in air fresheners and cleaners that contain other essential oils for fragrance. They react with ozone to form formaldehyde, an asthmagen and known human carcinogen.

The California Air Resources Board recommends that consumers avoid using citrus and pine oil cleaners, especially on warm, smoggy, high-ozone days (CARB 2008). Ozone-forming volatile organic compounds and ozone-reactive terpenes from pine and citrus oils may act together to increase formaldehyde air pollution. The combined effects on air quality of cleaning products that release these chemicals have not been studied and are a cause for concern.

Childhood asthma is at an all-time high

Surveys by the federal Centers for Disease Control and Prevention have detected a dramatic increase in childhood asthma across the country over the past few decades. At present, nearly 1 of every 10 children in the U.S. – 9.3 percent of the U.S. population under age 18 – has asthma (CDC 2008), up from 7.5 percent in 1996 and just 3.6 percent in 1980 (CDC 2006). Childhood asthma is more common in African-American, Latino and low-income communities (CDC 2006; Babey 2007; Meng 2007). More asthma sufferers are being hospitalized than at any other time in American history, mirroring the documented trends in asthma prevalence (CDC 2006). The annual direct medical cost of asthma in children and adults for the year 2007 was estimated at $37 billion nationwide (Kamble 2009). Reducing in utero and childhood exposures to cleaning supplies that pollute the air with asthmagens and lung irritants may constitute an important investment in a healthy future.

Cleaners and Cancer

EWG's survey of product ingredients disclosed by manufacturers found that many cleaners may be laced with known, probable or possible carcinogens, including:

- Formaldehyde (sometimes called formalin). Designated by the U.S. government and World Health Organization as a known human carcinogen, formaldehyde is listed on labels or worker safety documents as an ingredient in dozens of cleaners in the EWG's Guide to Healthy Cleaning. Formaldehyde may also be generated in cleaning product containers by formaldehyde-releasing preservatives such as bronopol (also known as 2-bromo-2-nitropropane-1,3-diol). In this situation, manufacturers do not add formaldehyde itself to the product, but instead they add preservatives that release formaldehyde in order to kill bacteria and extend the product's shelf life. EWG's tests of cleaning products used in California schools detected formaldehyde in Comet, Pine-Sol and Simple Green cleaning products. Formaldehyde vapors have been detected when citrus- and pine-based ingredients mix with ambient ozone inside homes (CARB 2008). Formaldehyde formation is worst on smoggy days, when ozone levels are high.

- 1,4-Dioxane. Classified as a probable human carcinogen by the EPA, this chemical has been detected in a number of brand-name liquid laundry detergents (Steinman 2010). This substance is an impurity unintentionally formed during industrial processes that make synthetic ingredients such as PEG and polyethylene compounds. Several animal studies have found higher rates of liver tumors in animals exposed to 1,4-dioxane. Studies of occupational exposure have been inconclusive (EPA 2010).

What are the risks of using cleaning products that contain chemicals that may turn out to be cancer causers? This question hasn't been studied very often. One recent retrospective study by the Silent Spring Institute that surveyed 1,500 Massachusetts women, half of whom had been diagnosed with breast cancer, suggested a link between using household cleaners and cancer (Zota 2010). Women who reported the greatest use of cleaning products (top 25 percent) were twice as likely to have been diagnosed with breast cancer as those reporting the least use (bottom 25 percent). Higher risk was also associated with frequent use of air fresheners, especially solid ones, and mold- and mildew-control products. The study authors cautioned that the evidence was not clear-cut, because some women's responses could have been affected by their subjective beliefs that chemicals and pollutants might have contributed to the development of their illnesses.

More research is urgently needed to investigate possible links between chemicals in cleaning supplies and cancer. While it's clear that many common cleaners contain carcinogenic ingredients or impurities, scientists do not know to what extent these exposures may contribute to cancer risk.

Cleaners and Reproductive or Developmental Problems

EWG's survey of cleaning product ingredients disclosed by manufacturers identified several specific chemicals that are known or suspected reproductive or developmental toxicants, including:

- Borax and boric acid. These compounds are used to stabilize enzymes in laundry or dishwashing detergents and borax is a common ingredient in homemade cleaners as well. Sodium perborate, a form of oxygen bleach found in some cleaners, releases sodium borate during the bleach process. The European Union considers them toxic to human reproductive systems (ECHA 2011). Men working in boric acid-producing factories have a greater risk of decreased sperm count and libido. Chronic exposure to high doses of borax or boric acid causes testicular atrophy in male mice, rats and dogs (EPA 2006). Female test subjects show reduced ovulation and fertility at higher doses. Animal studies of high-dose exposures to borax and boric acid have found that they can cross the placenta, affecting fetal skeletal development and birth weight. Risk assessments by U.S. and E.U. agencies have not comprehensively examined exposures from cleaning supplies in relation to other sources of exposure such as pesticides, personal care products, food and water, making it difficult to assess the specific level of risk from borax or boric acid detergents and cleaning supplies (EPA 2006; European Commission 2007; ECHA 2008). Boric acid is a candidate for the E.U.'s list of substances of "very high concern" for which health-protective regulation is a priority (ECHA 2010).
- Diethylene glycol monomethyl ether. This solvent is also known as DEGME or methoxydiglycol and is found in a few heavy-duty cleaners and degreasers. The European Union suspects this chemical of damaging fertility or the developing fetus (ECHA 2011) and has essentially banned it in cleaners (EU 2008). Other chemicals in the glycol ether family have been linked to impaired fertility and reproductive and developmental toxicity in animal studies (EPA 2000; NTP 2000). Four are on California's Proposition 65 list of male developmental toxins. Occupational studies indicate that men exposed to glycol ethers on the job are more likely to have reduced sperm counts, and that pregnant women exposed on the job are more likely to give birth to children with birth defects (Cordier 1997; CDHS 2007). These solvents are readily absorbed through the skin or via inhalation and can reach toxic levels in the body.

A 2010 study conducted by the New York State Department of Health that analyzed maternal occupation and 45 types of birth defects indicated that children born to women working as building custodians have a significantly increased risk of certain congenital deformities (Herdt-Losavio 2010). Other occupational studies have highlighted risks of solvent exposure for a group of children born to women working with organic solvents during pregnancy. Some of the children in this category had reduced IQ and language skills (Till 2001; Laslo-Baker 2004) and vision abnormalities (Till 2005). Few studies have probed the reproductive or developmental risks tied to cleaners, a troubling gap in our understanding of the potential effects of long-term exposure to these common consumer products.

Cleaners are Loaded with Allergens and Irritants

Ordinary cleaners can cause some people to suffer mild to severe allergic reactions of the skin, eyes and lungs. In rare cases, these reactions can require hospitalization. Some cleaning products contain chemicals that can trigger an allergy by themselves, while others have ingredients that can combine with proteins to form "haptens" that trigger reactions (Chipinda 2011). Linalool, commonly found in fragrances and essential oils, is one hapten-forming chemical (Christensson 2010; Karlberg 2008). The resulting allergic reactions can either develop quickly after only a few exposures or slowly after frequent, long-term exposures to lower concentrations of allergenic substances (Chipinda 2011).

Many harsh chemical cleaners can cause direct, painful irritation of the skin, eyes, nose, throat and lungs. The very properties that make cleaning products effective can also mean that they inflame delicate tissues.

A recent survey of Italian household cleaning supplies indicated that many common ingredients including preservatives, fragrances, solvents and surfactants are skin allergens or irritants (Magnano 2009). Some respiratory allergens and irritants can cause asthma or make asthma symptoms worse.

Repeated exposure to chlorine bleach has been linked to respiratory damage and wheezing as well as nose and eye irritation. Bleach fumes consist of a complex mixture of toxic, carcinogenic and irritating gases, including chlorine, chloroform and carbon tetrachloride (Medina-Ramon 2005; Odabasi 2008). Spanish scientists have documented increased risk of symptoms of obstructive lung disease in domestic workers who regularly use bleach (Medina-Ramon 2006). Bleach cleaners applied as sprays may be more likely to cause respiratory irritation and are of particular concern for work-related asthma (Medina-Ramon 2005).

The risks of bleach are not limited to those who clean for a living. A 2009 study from a 13-country research team found that people who used bleach at home four or more times per week were more likely than non-bleach users to suffer lower respiratory tract symptoms such as wheezing, coughing and shortness of breath (Zock 2009).

A 2009 assessment by the Massachusetts Department of Public Health of 49 custodial staff found that many suffered symptoms including sore throat, eye irritation, rashes and headaches (Pechter 2009). Seventy-eight percent of them reported that they associated at least one such symptom with using particular cleaning supplies.

A study published last year by the Technical University of Dresden found that 19 percent of 803 female cleaning workers developed skin allergies, also known as atopic dermatitis, and nearly one in three had contact dermatitis, a reaction that results in inflamed, red and itchy skin (Liskowsky 2011).

Exposures to irritating or allergenic cleaning ingredients can affect people who live, work or study in buildings undergoing cleaning. Volatile fumes released during ordinary cleaning can contaminate the air for up to 20 minutes after use (Bello 2010). Ammonia fumes from ammonium-based cleaning products are a potent irritant. Glycol ether fumes have been linked to increased risk of asthma, eczema, rhinitis (irritation and inflammation of the mucous membranes in the nose) and other allergic symptoms in pre-school age children (Choi 2010).

Mystery fragrance chemicals are a major allergy problem

Some respiratory allergies may be set off by fragrances, which are complex chemical mixtures commonly used to scent air fresheners and cleaners, personal care products and other consumer goods.

Fragrances are collectively considered among the top five allergens in the world (de Groot 1997; Jansson 2001). They can also trigger asthma attacks (Norback 1995; Millqvist 1996). Researchers at the Universities of Washington and West Georgia who surveyed everyday Americans' experiences with fragranced cleaning supplies found that nearly one in five suffered headaches, breathing difficulties or other problems when exposed to air fresheners (Caress 2009). A study led by Alexandra Farrow of Brunel University in the United Kingdom linked air fresheners in the home to higher incidence of diarrhea and earaches in infants and headaches and depression in their mothers (Farrow 2003). A Swiss study published this year found that use of air freshening sprays 4-7 days a week was associated with reduced heart rate variability, a marker of autonomic cardiac dysfunction (Mehta 2012). Because manufacturers routinely refuse to list individual ingredients in fragrances, independent researchers have difficulty conducting targeted studies to identify which fragrance chemicals raise the greatest concern.

Enzymes added to laundry and dishwashing detergents to break down and remove soils and stains have been linked to respiratory allergies in occupational settings. Manufacturers have taken steps to reduce exposure by encapsulating these enzymes, but workplace studies suggest that problems remain. For example, recent studies of factory workers manufacturing detergents by both the Netherlands Expertise Centre for Occupational Respiratory Disorders and the Finnish Institute of Occupational Health detected an increased risk of sensitization and respiratory allergy (Vanhanen 2000; van Rooy 2009). Workers with higher exposure to detergent enzymes also had greater symptoms of sneezing, itchy nose, rhinitis and wheezing. Industry-funded studies suggest that ordinary use of household cleaners containing enzymes poses no risk to consumers (Basketter 2010; Sarlo 2010; Weeks 2010).

Cleaning Supply Accidents: Chemical Burns and Poisonings

Many household cleaners can cause severe damage when ingested or splashed directly onto the skin and eyes. Though Americans are aware of the acute toxicity of some cleaning supplies, statistics on hospital visits and poison control calls make clear that accidents with cleaning supplies occur daily.

Chemical burns from caustic cleaners

Cleaning products that are extremely acidic or alkaline or contain corrosive ingredients can cause painful burns to the skin and eyes and permanent tissue damage or scarring. Inhaling fumes from these products can harm the lungs. Cleaning professionals can suffer serious chemical injuries on the job.

A 1999 study found that every year, for example, 6 of every 100 building custodians in Santa Clara County, Calif., experienced chemical-related injuries; 20 percent were serious burns to the eyes or skin (Barron 1999).

A review of records of 94 patients admitted to a hospital burn unit for chemical burns over a 19-year period found that 14 percent were injured at home with ordinary household cleaning products (Wibbenmeyer 1999).

One of the most serious immediate hazards is the formation of high levels of harmful gases when strongly reactive cleaning products are mixed. Bleach-based products pose the greatest hazard. Chloramine gas forms when bleach- and ammonia-based cleaners are mixed. Chlorine gas forms when bleach-based cleaners are mixed with acidic cleaners such as toilet bowl cleaners, rust removers or vinegar.

Poison under the sink

In 2010, American poison control centers fielded more than 116,000 calls about household cleaner accidents involving children under age five (Bronstein 2011). U.S. emergency room records show that in 2006 alone, 10,318 children under age five required some form of medical treatment as a result of poisoning with household cleaners, and 744 of them had symptoms that were life-threatening or resulted in significant disability (McKenzie 2010).

Bleach was the most common cause of poisoning or injury (McKenzie 2010). Spray bottles of cleaners were the most common means of exposure, involved in 40 percent of the accidents (McKenzie 2010). Although rates of

household cleaner-related injuries to children from regular bottles or original containers and kitchenware have decreased in recent decades, spray bottle injury rates remain high (McKenzie 2010). Many common spray cleaners have brightly colored packaging that fascinates inquisitive young children. Parents sometimes neglect to twist the cleaners' spray nozzles into an "off" position or children reopen closed nozzles.

These injuries are tragic – and unnecessary. There are safer cleaning products on the market that do not risk lasting damage to small explorers.

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