

Generations at Risk:

How Environmental Toxicants May Affect Reproductive Health in California

A Report by

Physicians for Social Responsibility (Greater SF Bay Area & Los Angeles Chapters) and
The California Public Interest Research Group Charitable Trust

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Physicians for Social Responsibility (Greater San Francisco Bay Area and Los Angeles Chapters)

Physicians for Social Responsibility (PSR) is a national organization of over 15,000 health care professionals and supporters which was founded in 1961. PSR works to address the public health effects of weapons of mass destruction, environmental degradation and community violence. With its international affiliate, International Physicians for the Prevention of Nuclear War, PSR received the 1985 Nobel Peace Prize for its efforts to eliminate nuclear weapons. The Greater San Francisco Bay Area and Los Angeles Chapters work to educate the medical community and the public about the linkages between environmental exposures and human health, and to encourage health professionals to participate in creating a sustainable and healthy environment. Members provide technical assistance and information on human health and environmental issues to citizens groups, health care providers, educational institutions and public policy makers.

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The California Public Interest Research Group (CALPIRG)

The California Public Interest Research Group (CALPIRG) is a non-profit, non-partisan public interest organization with over 70,000 members in California. Together with other state PIRGs across the country, CALPIRG has been at the forefront of the toxics movement for more than twenty years. The PIRG staff of attorneys, scientists, policy analysts, researchers and organizers have been instrumental in promoting the public's right-to-know about toxic chemicals and pressing government and industry to clean up and prevent toxic pollution. CALPIRG's Citizen Outreach Campaign reaches more than 250,000 households annually, and through its 7 campus chapters the organization helps to educate new generations of citizens and leaders.

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Reviewers

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Executive Summary

California based Physicians for Social Responsibility (PSR) and the California Public Interest Research Group (CALPIRG) Charitable Trust have joined together to prepare the report *Generations at Risk: How Environmental Exposures May Affect Reproductive Health in California*. This report brings together for the first time information about the reproductive health effects of selected chemical exposures with California chemical use and emissions data.

Major findings of the report include:

1. Of the more than 75,000 synthetic chemicals in commercial use today, only a small fraction have been adequately examined for toxic effects in humans and other life forms.
2. Despite limited scientific information, there is solid evidence of the reproductive toxicity of many substances that are widely used in commerce, including solvents, metals, and pesticides. Emerging evidence suggests that hormone (endocrine) disruption, which has long been identified but largely ignored, is a frequently occurring mechanism of toxicity.
3. Federal and state regulations are frequently not written or implemented in ways protective of human health and the environment.
4. Of industries required to report chemical use or release, including pesticide applicators, California businesses used or released more than 306.8 million pounds of chemicals associated with reproductive or developmental disorders from 1991 to 1995.
5. While California facility emissions of reproductive and developmental toxicants have declined over this period, use of these chemicals in agriculture is rising steadily. Total releases of these chemicals is increasing.
6. Right-to-know legislation like the federal Toxics Release Inventory (TRI) and California pesticide use reporting system provide the public with essential information which is rightfully theirs about toxicants to which they may be exposed. However, information gaps and accessibility problems show that these laws do not go far enough. While the TRI has been widely used to encourage facilities to reduce emissions, the California Pesticide Use Reporting Program data remains under-utilized and bears untapped potential for reducing pesticide use.
7. In order to protect the public from known and sus-

pected reproductive toxicants, policymakers, industry managers, members of the medical and scientific communities and individual citizens must all adopt a precautionary approach when making personal and public decisions that may result in exposure to these chemicals.

The Scope of the Problem—Extensive Exposure, Limited Information

More than 75,000 synthetic chemicals and metals are currently in commercial use in the US. The toxicity of most of these is unknown or incompletely studied. In humans, exposure to some may cause cancer, reproductive and developmental disorders, adverse neurological and immunological effects, or other injury. Reproductive and developmental effects are of concern because of important consequences for couples attempting to conceive and because exposure to certain substances during critical periods of fetal or infant development may have lifelong and even intergenerational effects.

Unfortunately, toxicological information is often incomplete. Animal testing usually looks at health effects using one chemical at a time. This strategy fails to provide information about interactive effects which may occur with exposure to more than one chemical. Moreover, animal tests often fail to examine for subtle, delayed, or difficult-to-diagnose conditions. Epidemiological (human) studies are often limited by inaccurate exposure assessments and incomplete information about health outcomes. Further complicating matters, the federal government is reducing its support for research and information analysis. Corporate funding is filling the void, providing an opportunity for bias in study design and data interpretation.

Some Chemicals Known, Some Suspected, as Reproductive Toxicants

Some of the specific synthetic chemicals or metals reviewed in this report are known to harm human reproduction or development. Lead and mercury, for example, disrupt brain development in the fetus. Solvent exposures are associated with spontaneous abortions in female workers. Several specific solvents have additional adverse effects — glycol ethers damage male reproductive function, and toluene causes birth defects at high levels of maternal exposure. Many Californians, particularly farm

workers, are exposed to mixtures of pesticides and are at increased risk of spontaneous abortion and birth defects in offspring. Some pesticides, like the fumigant, ethylene oxide, used to sterilize medical equipment, or the fumigant, methyl bromide, and herbicide, cyanazine, used in California agriculture, are identifiable as particularly associated with adverse reproductive outcomes. While the scientific evidence is weaker and still emerging, many other chemicals are also likely to adversely impact human reproduction. Suspects include manganese, several solvents including xylene, styrene, and perchlorethylene, and numerous pesticides and plasticizers.

Animal testing reveals that a single dose of a tiny amount of dioxin administered during a critical “window of vulnerability” in pregnancy can lead to life-long health effects in offspring. Men exposed to Agent Orange, an herbicide containing dioxin, are more likely to father children with birth defects. In addition, maternal exposure to PCBs seems to result in developmental delays in children. Dioxin and PCBs are examples of chemicals which appear to derail human reproduction and development by interfering with hormones. Other chemicals which may also be endocrine disruptors in humans are commonly found in consumer products such as plastics, paints, detergents, cosmetics, and pesticides. While the full significance of some of these newly recognized or suspected reproductive and developmental toxicants is not yet clear, there is reason for concern about a wide range of chemicals and their potential effects on human health.

The Need for Policy Reform—Using Precaution as a Guide

Laws which regulate human and environmental exposure to hazardous substances generally take one of two possible approaches — “better safe than sorry” or “innocent until proven guilty.” We believe that a “better safe than sorry,” or precautionary approach, should guide risk management and regulatory decisions. This means that the issue of safety should be thoroughly considered before human and environmental exposures are permitted. No hazardous substance should be allowed to slip through the cracks because of a lack of information, time, or funding. Where there is some evidence of human or environmental toxicity, the precautionary approach demands that exposures be avoided or minimized.

Federal legislation which regulates pesticides and pharmaceuticals, for example, intends that manufacturers provide evidence of safety before a product is released for use — a seemingly cautious approach. But for many pesticides which were in use for years and “grandfathered” when EPA took over the pesticide registration process, safety studies are seriously inadequate. The special review process designed to address these deficiencies will not be complete for years. Moreover, despite the legislative intent, animal testing used to support an application for new pesticide registration currently fails to examine adequately for subtle and delayed toxicity. Furthermore, the registration process for pesticides does not account for interactive or cumulative effects of multiple exposures that individuals are likely to experience in real-world situations (recent legislation would address the problem of cumulative pesticide exposures, though it remains unclear if the law can or will be effectively implemented). Finally, there is no comprehensive evaluation of the impact such chemicals may have on the environment generally.

For most industrial chemicals, however, there is no absolute requirement for advance demonstration of safety before the product enters the commercial market. For example, under the Toxic Substances Control Act, the only legislation which addresses chemicals not covered by other laws, the Administrator of the Environmental Protection Agency must have reason to believe that a substance poses unreasonable risk to health or the environment before proposing controls - i.e., the chemical is “innocent until proven guilty.” Though the law states that the Administrator should have adequate data on which to base a decision, there are no standard testing protocols which are required before the chemical is released for use. And, with chemical manufacturers announcing more than 1,000 chemicals for production annually, the political and economic pressures to avoid thorough safety review are enormous. Appropriate screening and testing have never been practical possibilities under existing law. Moreover, industry has frequently abused “confidential business information” provisions in the legislation, effectively concealing the nature of industrial chemicals to which many people are exposed.

What Right-to-Know Data Reveal:

Trends in Selected Chemical Use and Environmental Releases — Leading Industries, Facilities, Municipalities

The federal Toxics Release Inventory (TRI) and the California Pesticide Use Reporting Program are two landmark laws that require public disclosure of chemical release by large manufacturing facilities and pesticide applicators, respectively. Each is based on the fundamental principle that individuals have the right to know the identity of substances to which they are or might be exposed. Because of the TRI, information is now available throughout the country about emissions of some toxic substances from selected industrial sources. In California,

information about pesticide use is also available.

This report quantifies the use and release of 78 “listed chemicals” which have been identified as reproductive and developmental toxicants by government agencies or by weight of the evidence published in the scientific literature, as evaluated by the authors (see Table 1). In addition to this list, this report discusses the reproductive and developmental effects of additional chemicals for which use and release data are not available or for which the weight of evidence was not deemed sufficient for listing. For a variety of reasons, many chemicals are not adequately reported under the Toxic Release Inventory or the Pesticide Use Reporting Program.

Table 1: Chemicals Identified as Developmental and Reproductive Toxicants

2,4-DB	LEAD
2,4-D	LINDANE
ACEPHATE	LINURON
AMITRAZ	MALATHION
ANILAZINE	MANCOZEB
ARSENIC	MANEB
ATRAZINE	MANGANESE
BENOMYL	METAM SODIUM
BENZENE	METHOXYCHLOR
BROMACIL, LITHIUM SALT	METHYL BROMIDE
BROMOXYNIL	METHYLENE CHLORIDE (DICHLOROMETHANE)
CADMIUM	METRIBUZIN
CARBARYL	MOLINATE
CARBON DISULFIDE	MYCLOBUTANIL
CHLORPYRIFOS	N-METHYL-2-PYRROLIDONE
CHLORSULFURON	NALED
CYANAZINE	NITRAPYRIN
CYCLOATE	OXYDEMETON-METHYL
CYPERMETHRIN	PARATHION
DI(2-ETHYLHEXYL) PHTHALATE	PENTACHLOROPHENOL (PCP)
DIAZINON	PERCHLOROETHYLENE (TETRACHLOROETHYLENE)
DICAMBA	PERMETHRIN
DICLOFOP	PHENOL
DICOFOL	PROMETRYN
DIENOCHLOR	PROPARGITE
DIMETHOATE	SIMAZINE
DIURON	STYRENE
ENDOSULFAN	TAU FLUVALINATE
EPTC	TEBUTHIURON
ETHYLENE OXIDE	TETRACHLORVINPHOS
FENBUTATIN-OXIDE	THIABENDAZOLE
FENOXAPROP ETHYL	THIOPHANATE-METHYL
FENOXYCARB	TOLUENE
FENVALERATE	TRIADIMEFON
FLUAZIFOP-BUTYL	TRICHLOROETHYLENE
FORMALDEHYDE	TRIFORINE
GLYCOL ETHERS	VINCLOZOLIN
HEXACHLOROBENZENE	XYLENE
IMAZALIL	ZIRAM

Environmental releases by California manufacturing facilities of chemicals with evidence of reproductive toxicity have declined substantially over the most recent five year period for which data are available. Emissions of these listed chemicals have declined 47% between 1991 and 1996, to 10.6 million pounds in the most recent year. However, the amount of these chemicals reported transferred offsite for recycling, treatment or disposal has increased, on average, over this time period, totalling 35.3 million pounds in 1996 (though transfers decreased from 1995 to 1996). Many of these transfers will inevitably re-circulate into the environment via leaking landfills, incinerator emissions or unsafe recycling practices.

Industries transferring and releasing the bulk of these chemicals include:

- Fabricated metal products
- Rubber and miscellaneous plastics
- Petroleum refining
- Transportation equipment

Toluene, styrene, glycol ethers, perchlorethylene and methylene chloride (also called dichloromethane) were all released in large amounts by California facilities. Toluene comprised 18% of total releases by manufacturing facilities. Several studies have demonstrated an increased risk of spontaneous abortion in women exposed to toluene in the workplace. The chemical is toxic to fetuses in animal studies at doses well below those causing maternal toxicity and is known to the state of California to be a developmental toxicant.

Approximately half of all facility releases of listed developmental and reproductive toxicants occurred in two southern California counties – Los Angeles and Orange. In northern California, Santa Clara, Alameda, and Contra Costa ranked highest for releases of listed chemicals.

Relative to reported releases by manufacturing facilities, California pesticide applicators are using and releasing many more pounds of reproductive and developmental toxicants. Fifty eight million pounds of these pesticides were reportedly used in 1995. Furthermore, use of reproductive and developmentally toxic pesticides is

increasing steadily, rising by almost 3 million pounds per year between 1991 and 1995. Numerous studies suggest that pesticide exposure is widespread and a high percentage of the population currently carries pesticide residues in body tissues and fluids.

Like total California pesticide use, the bulk of use for those chemicals identified as reproductive and developmental toxicants occurs in agriculture. Agricultural pesticide use poses high exposure risk to farmworkers and may also be a source of significant exposure for those living in rural communities, consuming contaminated groundwater or eating pesticide residues on food. Approximately 40% of listed chemicals applied as pesticides were used on carrots, cotton, strawberries and almonds in California.

Listed pesticides were also used extensively for non-agricultural applications. Over three million pounds were applied in and around buildings in California in 1995. In a recent CALPIRG survey, half of 46 California school districts – representing one in four of all California school children – reported using pesticides identified by U.S. EPA as reproductive and/or developmental toxicants in schools and on school grounds.

As expected, the bulk of these chemicals are used in the Central Valley, the nation's agricultural epicenter. Highest using counties include Fresno, Kern, Imperial, Monterey, Tulare, Merced, San Joaquin, Stanislaus, Kings, and Riverside counties.

To the degree that right-to-know laws have contributed to the decrease in emissions they have been useful for protecting public health. However, their ultimate validity rests in their recognition of the public's right-to-know, irrespective of incentives they provide for reducing toxicant use and releases. Such laws ensure that the public has the information required to make policy decisions and give individuals access to information they may need to protect themselves. We support efforts to expand each of these laws to include chemical use information; add additional industries and hazardous substances; and to make the data more readily available and understandable to the general public. We also encourage greater use of the Pesticide Use Reporting Program, both to encourage pesticide use reduction and generate demand for improving this under-utilized resource.

Policy Recommendations

We base our policy recommendations on three fundamental principles. They are:

1. Minimization of Chemical Use and Exposure

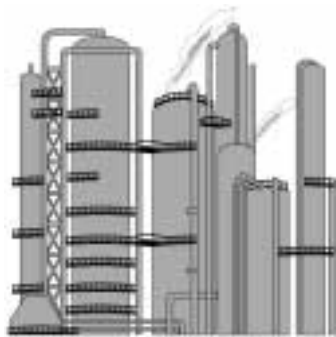
Strategies to eliminate unnecessary use, switch to safer alternatives, and a goal of zero-discharge of toxic chemicals should inform our decision-making.

2. The Precautionary Principle

The burden of proof must be placed on the industrial producer to prove that their chemicals are safe for use, rather than on the government or the public to prove that human health is being harmed.

3. Right-to-Know, Right-to-Education, Right-to-Training

We believe that all members of the public, both in and outside of the workplace, have the right to be fully informed about the chemicals that they are likely to come in contact with and the potential health hazards associated with those chemicals. Adequate information and education is essential for responsible personal and public decision-making where chemical exposure and proliferation may occur. Finally, disclosure has proven to be a highly effective tool in creating incentives for pollution prevention.



Introduction

Though it has been known for decades and, in some instances, centuries, that harmful health effects may result from environmental exposures, cancer often dominates the public agenda, receiving the most attention. There is, however, ample reason for concern about other health outcomes which may be subtle, delayed, difficult to diagnose, and not easy to link causally to specific exposures. Non-cancer effects include neurotoxicity, adverse effects on the immune system, reproduction and development, and injury to other individual organs. Reproductive and developmental toxicity are of concern not only because of important consequences for couples attempting to conceive but also because exposure to certain substances during critical periods of fetal or infant development may have lifelong and even intergenerational effects.

This report is the result of a collaboration between public health professionals, environmental organizers, and policy advocates. It is designed to raise awareness about known and suspected threats from reproductive toxicants in our environment and to provide a resource to help inform citizens, the medical community, advocacy groups, policy makers, growers, and industry. It is our hope that it will help to bring about changes necessary to minimize human exposures to potentially harmful substances.

In some cases there is compelling evidence of a cause-and-effect relationship between exposure to certain substances and reproductive or developmental disorders such as infertility, spontaneous abortions, and structural or functional birth defects. In others, the science is less clear, but a developing body of evidence is suggestive. Often, crucial missing information makes it impossible to draw definitive conclusions. These data gaps may result from incomplete animal toxicity testing and epidemiological studies which are inadequate or inconclusive. Information about human exposure to potentially toxic chemicals is also severely limited. Excessive work-

place exposures are often unmeasured and unreported. Estimates of the use, release, and exposure to many chemicals with endocrine-disrupting potential are unavailable.

But important information is also missing because of inadequate attention to the relationship between human health and the environment. A comprehensive awareness of that relationship requires that one understand an illness not just as an individual condition but also as a public health concern. Because medical education is generally deficient in addressing the link between human health and the physical environment, health-care personnel are often ill-equipped to recognize, much less treat, illnesses with environmental causes. We need to address these important deficiencies in medical education and research. Medical practice from an expanded public health perspective offers additional insights and opportunities. It does not shy away from using appropriate political action as a tool for protecting human health.

Yet even as this report demonstrates examples of major information deficiencies, public funds for medical and scientific research are being reduced. Increased corporate funding is helping to fill the void, and in the process, influencing the fundamental nature of studies and raising the possibility of inappropriate bias in the presentation of data. In this report, for example, we describe how commercial corporate interests caused the intentional suppression of information about the spermatotoxic effects of a pesticide (DBCP) when pesticide regulation was under the control of the US Department of Agriculture. As a result, hundreds of agricultural workers were sterilized. Successful recent efforts to reduce EPA funding will not only limit the agency's oversight and enforcement capacity but also its research agenda and potential to broaden the scope of existing right-to-know requirements.

Government oversight of prescription drugs, pesticides, and other industrial chemicals varies widely. But what are the fundamental reasons why the interactive effects of pharmaceuticals are so widely studied while similar effects of pesticides and tens of thousands of industrial chemicals to which entire populations are exposed are largely unknown? Why do we know so little about the extent of those exposures? The burden often falls on a regulatory agency to prove an exposure unsafe rather than the opposite, allowing human and environmental exposures to untested materials for economic and political reasons.

For example, the Toxic Substances Control Act (TSCA) requires that the Administrator of the EPA must find that there is a reasonable basis to conclude that a chemical presents an unreasonable risk of injury to health or the environment - and must also consider the benefits of the chemical and the economic consequences of regulation—before proposing action to control exposures. And when considering the registration of newly-proposed pesticides, EPA must consider cost-benefit analyses as well as animal toxicity testing. Figures used in cost-benefit analyses are usually supplied by the affected industry and often emphasize the cost of regulatory controls to their operations while minimizing or ignoring potential health-related or environmental costs resulting from exposures during production, use, disposal, or complete life-cycle analysis. Human health costs are, of course, impossible to estimate if related health effects are unstudied, unknown, or unrecognized.

We intend this document to have varied uses for groups and individuals from diverse backgrounds and interests. Broad-brush summaries of normal reproductive and developmental physiology, a brief review of basic principles of reproductive toxicology, and general discussions of epidemiology and animal toxicity testing introduce what follows. These sections will be useful to some — unnecessary for others. As the reader will quickly see, it is virtually impossible to address the reproductive toxicity of all substances to which humans are potentially exposed. With over 75,000 synthetic chemicals currently in commercial use, and an estimated 1,000-2,000 newly introduced each year, the task is enormous. In many cases, their health effects are unstudied and unknown. Consequently, the reviews of solvents, metals, and pesti-

cides focus on substances to which many people are regularly exposed and provide examples of the strengths and weaknesses of current toxicological information and investigation. We have included a section on endocrine disruptors as a subject of considerable recent concern which demonstrates the limits of our understanding of an important mechanism of toxicity.

Each section concludes with a summary of the weight of evidence implicating the substance of concern as a reproductive toxicant. We have consciously omitted any discussion of the reproductive risks of alcohol, tobacco, drug use, and radiation. These hazards are well known and are repeatedly and adequately described elsewhere. Their absence from this document does not imply a lack of concern.

The risk of an adverse health effect depends on more than the presence of a hazardous substance. One must also be sufficiently exposed. All too often accurate assessments of human exposure are simply unavailable making the likelihood of harm impossible to estimate. The federal Toxics Release Inventory and the California Pesticide Use Reporting Program data begin to address that problem by requiring some industries and pesticide users to report their releases of listed chemicals. Part IV of this report, “The California Picture,” includes an analysis of relevant data from those sources. Though use and release of hazardous substances does not necessarily imply broad human exposure, the limited reporting requirement begins to document and quantify the possibility, and in many cases, likelihood of exposure. As such, these data are an important first step.

Elsewhere the substances of concern might be different as other states may have industrial operations peculiar to their region. But the medical literature reviews and discussion of right-to-know legislation will continue to be of assistance to those not familiar with the material. Those who find the introductory material elementary should move directly to other sections of the document which may be read as stand-alone pieces. Consider the rich bibliographies and list of available resources at the end of the document for additional information.

In this document we have identified a pattern of continuing exposure to some known, highly-likely, or suspected

reproductive and developmental toxicants. The consequences of these exposures are largely unknown to the general public, occupationally-exposed workers, and health-care providers. One of our goals is to shed additional light on this important topic for those who wish to make more informed decisions. But beyond that, we hope that readers will consider this material an example of the need for a broader public health perspective in their own work and when analyzing health care, research, social, political, and economic activity.

