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Toxics Use Reduction in the Home: Lessons Learned from Household Exposure Studies

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Abstract

Workers and fence-line communities have been the first to benefit from the substantial reductions in toxic chemical use and byproducts in industrial production resulting from the Massachusetts Toxics Use Reduction Act (TURA). As TURA motivates reformulation of products as well as retooling of production processes, benefits could extend more broadly to large-scale reductions in everyday exposures for the general population. Household exposure studies, including those conducted by Silent Spring Institute, show that people are exposed to complex mixtures of indoor toxics from building materials and a myriad of consumer products. Pollutants in homes are likely to have multiple health effects because many are classified as endocrine disrupting compounds (EDCs), with the ability to interfere with the body's hormone system. Product-related EDCs measured in homes include phthalates, halogenated flame retardants, and alkylphenols. Silent Spring Institute's chemical analysis of personal care and cleaning products confirms many are potential sources of EDCs, highlighting the need for a more comprehensive toxics use reduction (TUR) approach to reduce those exposures. Toxics use reduction targeted at EDCs in consumer products has the potential to substantially reduce occupational and residential exposures. The lessons that have emerged from household exposure research can inform improved chemicals management policies at the state and national levels, leading to safer products and widespread health and environmental benefits.

Keywords

Consumer products; Toxics Use Reduction; Endocrine disruptors; Indoor air; Exposure; Chemicals policy

1. Introduction

In response to growing concern about the effects of industrial pollution in the 1980s, particularly from industrial disasters such as in Love Canal, New York, and Bhopal, India, the federal government passed the Emergency Planning and Community Right-to-Know Act (EPCRA 1986), which led to the establishment of the Toxics Release Inventory (TRI) and gave workers and citizens unprecedented access to information about releases of toxic chemicals from industrial facilities [1]. Growing out of this "right-to-know" legislation were a series of pollution prevention laws passed by a dozen states in the late 1980s and early

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1990s, which reflected a shift in environmental policy from a focus on waste management toward pollution prevention [2].

The Massachusetts Toxics Use Reduction Act (TURA 1989)—the first comprehensive pollution prevention law in the country—specifically focuses on reducing toxics use and emissions in the manufacturing process [3,4]. While the dramatic reductions in chemical use and releases that have resulted from TURA have widespread benefits [5], particularly for the health of workers and nearby communities, there may be an opportunity to expand TURA's benefits to consumer health by targeting use of toxics in commercial goods such as consumer products and building materials.

Indoor environments are increasingly understood as important contributors to exposures for a wide range of pollutants [6-9]. During the past fifty years, changing patterns in consumer product and building material use have resulted in corresponding changes in chemical emissions indoors, including increases in the variety and levels of some chemicals [10]. Chemical concentrations are often greater indoors than outdoors due to multiple indoor sources and limited chemicals degradation and ventilation indoors [11,12]. Indoor exposures may be more relevant to health than ambient exposures given that people spend an estimated 90% of their time indoors [13]. Furthermore, recent trends in green building, which have focused on improving energy efficiency, have resulted in increasingly airtight homes. While these changes have been successful in decreasing energy loss, they may have the unintended consequence of trapping pollution inside, and thus increasing indoor exposure for some pollutants [14].

Indoor exposures to a few pollutants, such as lead, radon, tobacco smoke, and asbestos, have been extensively studied. However, some classes of chemicals commonly used in consumer products and building materials have received insufficient attention, including endocrine disrupting compounds (EDCs)—chemicals that can mimic or otherwise disrupt endogenous hormones. Although research on the health effects of EDCs is still developing, studies with animals and cell lines, as well as limited human studies, suggest EDCs may contribute to breast and other hormonal cancer risk, and adverse developmental and reproductive effects [15-19]. Examples of EDCs with consumer product sources include pesticides; polybrominated diphenyl ethers (PBDEs) and other flame retardants found in fabrics, polyurethane foam, plastics, and electronics; polychlorinated biphenyls (PCBs), persistent organic compounds widely used in electrical equipment, plastics, and caulk, and banned in 1979 due to concerns about their toxicity and persistence; phthalates, industrial chemicals used in plastics and personal care products; alkylphenols, surfactants used in detergents, pesticide formulations, and polystyrene plastics; and parabens, preservatives used in personal care products such as lotions [6].

Silent Spring Institute's research has focused on studying exposures to EDCs and mammary gland carcinogens—chemicals that cause mammary gland tumors in animal studies—and identifying potential sources of these compounds in the indoor environment. The Institute's Household Exposure Study has documented widespread exposure to a mixture of EDCs and mammary gland carcinogens in household air and dust [7,11,20]. To identify specific indoor sources of chemicals measured, Silent Spring Institute is evaluating and testing consumer products for a suite of EDCs and other chemicals of concern. The results of this research will be used to develop evidence-based guidelines for exposure reduction. In this article, we review the key findings from Silent Spring Institute's Household Exposure Study and product testing research. We examine the lessons that have emerged from this research and discuss the implications for chemicals management policies at the state and national levels.

2. Household Exposure Studies

2.1 Cape Cod Household Exposure Study

In the Cape Cod Household Exposure Study (HES), indoor air and house dust samples from 120 Cape Cod, MA, homes were analyzed for 89 EDCs, including phthalates, flame retardants, parabens, pesticides, alkylphenols, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) [7]. We surveyed participants about product use and housing characteristics, and interviewed a subset (n=25) of participants about their response to learning results for their own home [21]. For two homes with elevated levels of PCBs, we re-sampled air and dust, tested residents' blood, and inspected the homes and interviewed residents to investigate the source of the elevated levels [22].

The study documented widespread exposure to EDCs, with 67 compounds detected and an average of 24 compounds per home. Our findings likely underestimate the range of EDCs present in homes because we measured a limited set of compounds previously identified as EDCs, and most chemicals in commerce have not been screened for endocrine activity. Several EDCs were detected in all homes sampled, including bis(2-ethylhexyl)phthalate (DEHP, a common plasticizer used in polyvinyl chloride and personal care products) and 4-nonylphenol (a surfactant used in some laundry detergents, cleaning products, and plastics). The study provided the first reported indoor measurements for over 30 of the compounds, including the first measurements in US household dust of polybrominated diphenyl ethers (PBDEs, flame retardants found in fabrics, polyurethane foam, plastics, and electronics).

Because indoor air and dust are not currently regulated, we compared concentrations of chemicals detected in homes with EPA's risk-based guidelines for outdoor air and residential soil where available [23,24]. In all homes, the concentration of at least one compound exceeded the EPA risk-based guideline for air or soil; however, there are no guidelines for 28 of the compounds measured [7,25]. Moreover, the existing federal guidelines do not consider endocrine effects or the effects of complex mixtures of chemicals to which people are exposed. Characterizing risk based on exposures to single chemicals likely underestimates actual risk as studies have shown that mixtures of EDCs may have additive or other interactive effects when combined [26]. Overall, our results highlight the need to consider mixtures of chemicals when assessing risk.

2.2 Northern California Household Exposure Study

To assess how exposures to EDCs vary across geographic regions and socioeconomic status, we expanded the Cape Cod HES to include homes in Richmond, CA, an urban community bordering a Chevron oil refinery, transportation corridors, and other industry, and Bolinas, CA, a nonindustrial comparison community [20]. We collected paired indoor-outdoor air samples, as well as household dust samples, from 50 homes. Samples were analyzed for over 150 compounds, including metals and particulate matter (PM2.5), which are associated with industry and transportation, and EDCs, including phthalates, PBDEs, parabens, pesticides, alkylphenols, PAHs, PCBs, and other estrogenic phenols. We observed housing characteristics, and interviewed participants about product use, demographics, and their response to study findings.

We detected 104 compounds in indoor air in Richmond and 69 in Bolinas. In outdoor air, we detected 80 compounds in Richmond and 60 in Bolinas, including many EDCs that had not been measured previously in outdoor air. We found higher concentrations of EDCs in indoor air compared to outdoor air, and lack of correlation between indoor and outdoor concentrations for most of the chemicals, which suggests that they have primarily indoor sources. Indoor concentrations of the most ubiquitous EDCs were generally correlated with each other, highlighting the importance of considering exposure to mixtures of chemicals when developing chemical screening and exposure reduction strategies. For many polycyclic aromatic hydrocarbons (PAHs), which are products of combustion, outdoor and indoor air levels were correlated, demonstrating the influence of outdoor sources on indoor concentrations.

3. Lessons from the Household Exposure Study

3.1 Residential exposures to EDCs are widespread

Our household exposure research provides evidence that residential exposure to EDCs and other chemicals of concern is widespread. In the HES, we documented exposure to over 80 EDCs in household air and dust. Paired indoor-outdoor measurements provide evidence that consumer products and building materials play a significant role in indoor environmental quality. Given that exposure to chemicals with evidence of potential health effects in homes is substantial, we should be concerned about putting these chemicals into products and building materials, which can migrate into household air and dust.

3.2 Banning a chemical does not necessarily eliminate it

Residential exposures to pesticides and other chemicals from consumer products can persist even after the chemicals are banned. Persistence indoors is expected because many of these chemicals are semivolatile organic compounds (SVOCs), which are slowly released from sources over time and also have a tendency to partition onto surfaces throughout the home [27]. We detected the pesticide 4,4′-DDT, which was banned in 1972, in 65% of Cape Cod dust samples in 1999-2001 and 86% of California dust samples collected in 2006. Other banned and restricted pesticides frequently detected include chlordane, heptachlor, methoxychlor, dieldrin, and pentachlorophenol. Furthermore, many pesticides were detected at levels above EPA risk-based guidelines. The presence of these pesticides above health guidelines years after their use was prohibited or restricted illustrates that these chemicals do not easily degrade in the protected indoor environment and that banning chemicals is not always effective at removing exposure.

Unlike pesticides, which often display warning labels and include labeling for active ingredients, many chemicals of concern with consumer product sources enter homes unrecognized. For example, we found PCBs in nearly a third of the Cape Cod homes despite their being banned in the 1970s and having a reputation as industrial pollutants that did not have significant consumer uses. Follow-up testing of two Cape Cod homes with unusually high concentrations revealed that levels of PCBs in air and dust remained elevated five years after the initial sampling; and blood levels of long term residents of these homes were higher than the 95th percentile of those reported in the *3rd National Report on Human Exposure to Environmental Chemicals* [22]. During an interview, one participant recalled using the wood floor finish Fabulon. By consulting an out-of-print reference book, researchers discovered that Fabulon Bowling Alley Finish, which was used in the 1950s and 1960s, contained PCBs during this period (Figure 1). Thus, persistent chemicals used legally in consumer products in the past have created lingering health risks that are often difficult to identify without expensive testing. Evaluating the safety of chemicals before they are widely used in consumer products could avoid introducing this type of long-lasting risk in the future.

3.3 Consumer product standards influence household exposure

Residential exposures to EDCs may be influenced by specific standards related to consumer products and building materials. In our Household Exposure Study, we found penta-PBDE levels in California house dust were 10 times higher than other levels reported in the US and 200 times higher than in Europe, where the compound has been phased out [28]. The homes with the maximum concentrations were the highest ever reported in indoor dust. Blood levels of California residents in the National Health and Nutrition Examination Survey (NHANES) were nearly two-fold higher compared to residents of other states. These results show elevated exposure to penta-PBDEs in California, which is likely an unintended consequence of the state's stringent furniture flammability standard. The unique standard, which requires furniture to be resistant to an open flame for 12 seconds, spurred manufacturers to add penta-PBDE to household products such as polyeurethane furniture foam to meet the requirements.

In 2004, penta-BDE was banned in California and some other states. However, the persistent chemical lingers in many household furnishings. Furthermore, because manufacturers are still required to comply with the safety standard, they have replaced penta-BDE with alternative flame retardants that may not have been thoroughly tested for safety. Rather than substituting one harmful ingredient for another, we need a comprehensive framework for identifying safer alternatives for use in commercial products.

Other well-intentioned product standards may also have unintended exposure implications. For example, Leadership in Energy and Environmental Design (LEED)— the internationally recognized green building certification system [29]—provides rating incentives that encourage the use of some materials that may be sources of indoor pollution such as flame retardants from insulation and recycled carpet backing. Implications of LEED for indoor air quality have not yet been empirically evaluated.

3.4 Outdoor pollutants penetrate indoors

In addition to indoor sources, outdoor sources of some chemicals contribute to residential exposures. In our Northern California HES, we found exposures were generally higher in Richmond compared to Bolinas for compounds associated with industry and transportation. In nearly half of Richmond homes, PM2.5 levels exceeded California's annual ambient air quality standard. Paired indoor-outdoor correlations indicate outdoor air is an important source of indoor concentrations of some compounds, including PM2.5, PAHs, and metals. Levels of vanadium and nickel in Richmond outdoor air were among the highest in the state, implicating heavy oil combustion from the nearby refinery and marine port [20]. As with other compounds from industry and transportation sources, vanadium and nickel were migrating into homes. Other studies, which have focused on volatile organic compounds (e.g. Sax et al [30]) and $PM_{2.5}$ (e.g. Meng et al [31]), have also observed the impact of outdoor sources on indoor exposures. Taken together, these results illustrate the cumulative impacts of pollution from indoor and outdoor sources on indoor air quality. In order to address indoor exposures, TUR approaches need to target the combined effects of indoor and outdoor sources.

4. Developing evidence-based exposure reduction strategies

Many consumers seek guidance on how to reduce exposure to EDCs and other pollutants indoors. Although household exposure studies can document the presence of pollutants indoors, they often provide limited information about chemicals' specific sources and thus exposure reduction strategies. Moreover, source identification is hampered by a lack of information about product ingredients because some chemicals may not be listed on product labels, some may arise from product packaging materials rather than ingredients, and others may be present as byproducts. In some cases, manufacturers may not know the identity of chemicals in the components they purchase from manufacturers upstream [32].

While new initiatives, such as Good Guide™ [33], that rate products based on safety can provide some direction to consumers navigating product labels, the rating systems are restricted to information disclosed by manufacturers. Green Seal™ [34], EPA's Design for the Environment (DfE) program [35], and other third party certifiers also can help inform consumer product choices, however, they are limited in the scope of products and chemicals analyzed.

To help guide consumer product choices and potentially reduce indoor exposure to EDCs, Silent Spring Institute is seeking to develop evidence-based recommendations. These guidelines will also inform an intervention study designed to determine how much residential exposures can be reduced through product replacement.

4.1 Product selection

As a first step to inform exposure reduction, we selected household and personal care products for analysis. We chose individual products based on information about market share and availability and classified them as either “alternative” or “conventional” according to criteria related to product ingredients and marketing. We designated as “alternative” those products that we expected would contain minimal quantities of specific chemicals of concern, including suspected EDCs and mammary carcinogens (Table 1). Products that did not meet the criteria for alternative products were designated as conventional. Our criteria list is not intended to be exhaustive; that is, it does not consider all indoor pollution concerns such as irritants, asthmagens, and neurotoxins, but rather reflects EDCs in indoor air and dust in our Household Exposure Studies.

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4.2 Request for information on product ingredients

Product labels provide a preliminary but incomplete picture of product ingredients since the multitude of federal labeling laws—including the Federal Food, Drug, and Cosmetic Act (FD&C Act), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and the OSHA Hazard Communication Standard (HCS)—do not require full disclosure. Because analytical testing of products is expensive, we first attempted to obtain information about ingredients from manufacturers. We contacted 34 manufacturers of conventional (n=24) and alternative (n=10) products to inquire about specific ingredients, including requests for information beyond what appeared on product labels and material safety data sheets (MSDS's).

Most manufacturers we contacted did not provide complete responses. Of the 24 conventional product manufacturers we contacted, 70% provided no information (of those, 17% stated the information was proprietary), 13% provided only MSDS's even after we stated that was insufficient, and 17% provided some or all of the additional information we requested. Manufacturers of alternative products were slightly more willing to share product information. Of the alternative product manufacturers contacted, 20% provided no information, 20% provided only MSDS's, and 60% provided some or all of the additional information we requested.

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4.3 Product testing

Because we were able to obtain only partial information on product ingredients from labels and manufacturers, we tested 214 conventional and alternative household and personal care products for over 65 chemicals, including phthalates, fragrances, parabens, and antimicrobials. Products were purchased from local area stores and analyzed for a suite of neutral compounds and a suite of phenolic compounds

A composite sampling scheme for conventional products was used to minimize analytical costs. Specifically, 2-7 products within a product type category (e.g. bar soap, toothpaste, surface cleaner) were combined and analyzed as one sample. Our goal was to represent “typical” exposure using conventional products and to identify specific alternative products without our chemicals of concern. A total of 170 conventional products (mean = 4 per product type category) and 44 alternative products were analyzed.

All conventional samples had at least one detect; eleven alternative products contained no detectable amounts of targeted compounds. The average number of detected compounds was up to 8.7 in conventional products (uncertainty due to composite sampling) and 2.9 in alternative products. These results indicate that it is possible to select products with fewer compounds of concern based on inspection of product labels; although the efficacy of the selection process varies by product category.

4.4 Evaluating consumer product labels

One of the goals of developing criteria for selecting products is to help consumers make more informed product choices, so we evaluated the average consumer's experience trying to utilize the guidelines. With training from Silent Spring Institute researchers, student interns studied the labels of over 180 alternative and conventional cleaning and personal care products in two local area stores (Table 2). Products were chosen based on information about market prominence and availability. For each item, interns documented information about product price, environmental and health claims, ingredients, and any challenges to following the criteria for selecting alternative products (Table 1).

The exercise revealed a number of difficulties for shoppers. As the research team expected, some products did not list ingredients on their labels; and products with labels often did not indicate if all ingredients were disclosed. This made it impossible to determine which ingredients were present in or absent from many products. Helpful product labels advertised specifically that they were “phthalate-free” or “paraben-free.” Likewise, other products announced that they “disclose all ingredients” or were “EU compliant.”

In general, environmental and health claims were common, particularly on alternative product labels. Examples of frequently encountered claims include “natural,” “non-toxic,” and “safe.” These claims were not restricted to alternative products. For example, one conventional antimicrobial soap was advertised as “eco-smart.” Many of these claims are potentially misleading because the use of the terms in product labeling is not adequately regulated in the US: the US Federal Trade Commission has created some guidelines for environmental marketing, however, they are rarely enforced [36]. Lengthy claims also contributed to making label-reading time consuming; the interns took an average of five minutes per product to wade through ingredient lists and environmental and health claims. Interpreting the labels was challenging because ingredients could be listed under multiple names (e.g., surfactants), with abbreviations (e.g., monoethanolamine could be listed as MEA), in small print, or on the inside of the label. In sum, we found that although the criteria were useful for avoiding some chemicals of concern in some products, the lack of transparency about consumer product ingredients hinders consumers' ability to reduce their exposures.

5. Implementing lessons learned

Our household exposure study and product testing research illustrates the multiple challenges faced by consumers, researchers, public officials, manufacturers, retailers, and others who wish to identify and reduce exposure to EDCs and other chemicals of concern in commercial products. Household exposure studies have documented widespread exposure to EDCs in homes; however, it remains challenging to identify and reduce sources of exposure. Our analysis of household and personal care products reveals that this difficulty stems in part from inadequate labeling requirements and some manufacturers' reluctance to provide information about product ingredients. Although product testing can provide some useful

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information about selected chemicals of concern, it is a resource-intensive process that affords only a narrow snapshot of potential consumer product exposures.

While we continue to support individual efforts to reduce exposure, we recognize the need for a more comprehensive toxics use reduction approach that targets upstream sources of exposure and stimulates development of safer alternatives. The lessons that have emerged from our research can inform exposure reduction strategies at both the state and national levels. Our findings support the following goals for chemicals policy reform:

- Create a framework for evaluating the safety—including for endocrine effects—of new and existing chemicals, and alternatives to hazardous chemicals. This framework should include: 1) new toxicity testing requirements for commercial chemicals; 2) research and development of new techniques for rapid screening and prioritization of chemicals based on toxicity (e.g. EPA's ToxCast program); and 3) novel decision theory approaches that rely on available data to select the least toxic chemicals for particular uses.
- Shift the burden of proof. Instead of requiring government and the public to demonstrate a chemical's harm, require manufacturers to test for safety.
- Provide incentives and technical support to manufacturers for consumer product reformulation.
- Consider exposures to mixtures of chemicals, which can produce interactive effects, when assessing risk.
- Consider the impact of chemicals on human health through the full product lifecycle, including indoor exposure from product use.
- Promote public right-to-know by increasing transparency about product ingredients through labeling requirements.
- Build capacity for green chemistry—the design and manufacture of chemical products and processes that reduce or eliminate the use and generation of hazardous substances [37]—by supporting research and education.

5.1 State level

States can play an important role in achieving objectives for toxics use reduction. In addition to benefits at the local level, novel state chemicals policies can help catalyze reforms at the federal level. There are many options for state participation in chemicals management, including collecting data on chemical use, requiring manufacturers to label ingredients, creating incentives for information sharing, restricting what can be sold in the state, and providing technical assistance to manufacturers with product reformulation [38,39].

In the absence of an integrated federal approach, several states have already taken steps to address chemicals policy reform [40]. For example, California's new Green Chemistry Initiative provides a framework for chemicals policy reform in the state, which includes: promoting pollution prevention, increasing transparency about product ingredients, providing publicly available information about chemical safety, and improving consumer product safety and sustainability. Two state laws have already been passed that work toward these goals [41]. Other examples at the state level include recent laws targeting toxics in children's products in Maine and Washington, which incorporate TUR principles [42].

In Massachusetts, TURA has been successful in reducing toxics use and emissions in the state and has served as a model for other states and nationally. Building on this success, TURA has the potential to extend these benefits to include further reductions in exposure from consumer product use. Possible opportunities to expand TURA within its existing framework to achieve this goal may include: 1) focusing on opportunities for reductions in EDC use in consumer products during the TUR planning process; 2) expanding TURI's trainings to include information about indoor exposure to EDCs from commercial products; 3) supporting research on alternatives assessment for EDCs in consumer products; and 4) including additional EDCs and other emerging contaminants on the list of reported chemicals.

TURI has already demonstrated success in assisting with product reformulation. For example, electronics manufacturers, with TURI's help, have applied concepts from product life cycle assessment (LCA) to reduce the use of lead in their products [43]. Recent grants administered by TURI will support research on alternatives to bisphenol-A in epoxy can linings and brominated flame retardants in textiles. In addition, the state is considering a bill, H. No. 757 (2009) An Act for a Competitive Economy Through Safer Alternatives to Toxic Chemicals, which has the potential to expand the TURA program's ability to promote substitution of hazardous chemicals with safer alternatives in consumer products.

Although these opportunities and developments are promising, the TURA program is limited in the extent to which it can affect consumer product exposures. First, TURA generally only applies to companies that use large quantities of toxics; that is, companies that either manufacture or process 25,000 pounds or more of a reportable chemical per year or otherwise use 10,000 pounds (TURA §9A), and 1,000 pounds for a short list of “higher hazard substances” (TURA §9B). Confidential business information (CBI) claims, which prevent manufacturers from having to report product ingredients they consider trade secrets, provide another limitation to TURA's scope (TURA §20). Some of the most promising methods for addressing consumer product exposure, such as product testing and labeling requirements, are not covered by TURA. Finally, TURA does not address some types of products such as cosmetics and pesticides, or imported products used in Massachusetts homes. These limitations underscore the need for more comprehensive chemicals policies.

5.2 National level

While state level strategies will continue to be important, ultimately, a coordinated national approach to chemicals management is needed. Currently, a patchwork of laws comprises the fabric of U.S. chemicals regulation. The primary federal statute regulating industrial chemicals in the U.S., the Toxic Substances Control Act (TSCA 1976), is recognized by many as outdated and inadequate [44-46]. Wilson and Schwarzman have identified three main gaps in the framework for chemicals management in the U.S., including a lack information about chemical risk required from manufacturers (data gap); a lack of tools for government to take action to reduce exposures to hazardous chemicals (safety gap); and a lack of investment in green chemistry research and education (technology gap) [47]. Closing these gaps, the authors argue, will require fundamental chemicals policy reform that increases transparency and accountability, and promotes the development of green chemistry.

Responding to similar gaps, the European Union recently overhauled its chemicals management program by enacting the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH 2006) [48], which provides a unique opportunity to motivate chemicals policy reform in the U.S. [38,47,49]. Furthermore, the 2008-2009 President's Cancer Panel Report, “Reducing Environmental Cancer Risk, What We Can Do Now,” calls for adopting a precautionary approach to chemicals management in the US [50].

Some promising steps toward chemicals policy reform have already been taken at the federal level. The EPA recently expressed a commitment to rethinking chemicals management, including developing action plans and increasing public access to safety information for existing chemicals of concern [51-53]. The Endocrine Disruption Prevention Act of 2009 proposes to develop methods to identify EDCs with the goal of informing regulation, while the Safe Chemicals Act of 2010, the most comprehensive chemicals policy bill to date, aims to overhaul TSCA.

Looking forward, implementing a comprehensive chemicals management policy that addresses EDCs and other chemicals of concern in commercial products and stimulates the development of safer alternatives has the potential to substantially reduce indoor exposures that affect health. Just as Massachusetts was a leader in passing the nation's first TUR law, it could lead the way in initiating policies that reduce exposures at the state level and promote changes at the federal level.

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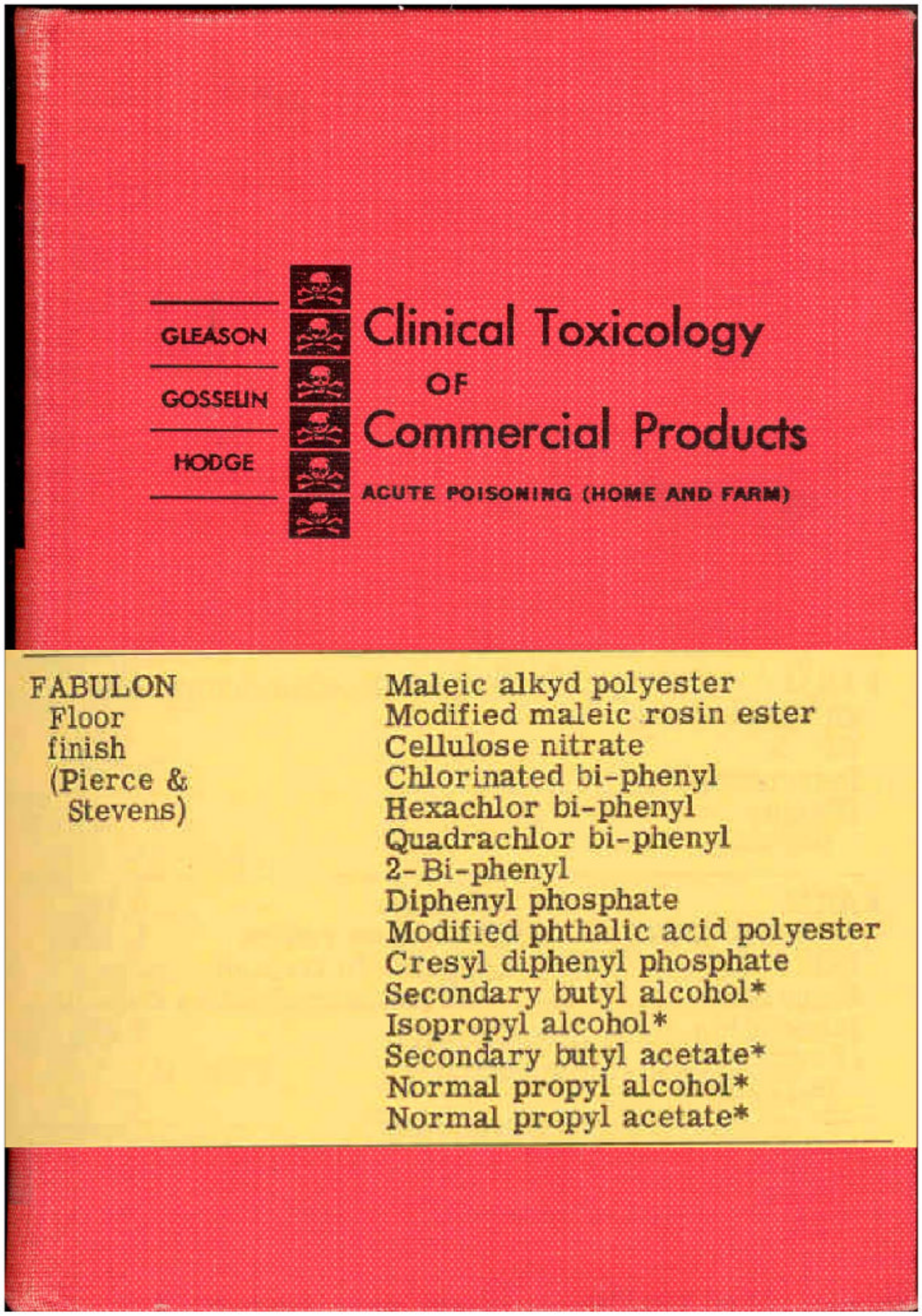

Figure 1.
Entry for Fabulon floor finish from 1957 edition of Gleason et al. *Clinical Toxicology of Commercial Products* lists PCBs among the ingredients.

Table 1

Selection criteria used to identify "alternative" consumer products

Products should contain/be
Primarily plant-based ingredients
Paraben-free
Fragrance-free (allow botanical extracts, except tea tree oil and lavender)
Products should not contain
Ethanolamines
Organofluorines (including labeled as being stain resistant)
Anti-microbials (e.g. triclosan)
Alkylphenol-based surfactants (i.e. nonionic surfactants)
Dichlorobenzene
Phthalates (including labeled as containing vinyl)

Table 2

Products evaluated in label reading exercise.

Store	Count
Alternative	108
Conventional	81
Product Type	
Alternative	114
Conventional	75
Product Category	
Air Freshener	7
All Purpose Cleaner	14
Conditioner	9
Deodorant	10
Dishwashing Soap	15
Dryer Sheets	9
Laundry Detergent	14
Lip Care	15
Lotion	21
Shampoo	7
Shaving	8
Soap	40
Sunscreen	9
Toothpaste	11
Total	189