Report to Congress on Workers' Home Contamination Study Conducted Under The Workers' Family Protection Act (29 U.S.C. 671a)

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL AND PREVENTION
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

SEPTEMBER 1995

DHHS(NIOSH) Publication No. 95-123

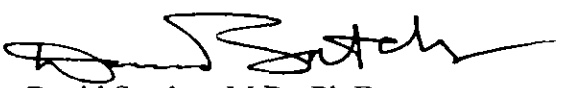
DISCLAIMER

Mention of any company or product does not constitute endorsement by the National Institute for Occupational Safety and Health.

FOREWORD

In 1992, the U.S. Congress passed the Workers' Family Protection Act (Public Law 102-522, 29 U.S.C. 671), which requested that the CDC's National Institute for Occupational Safety and Health (NIOSH) conduct a study to "evaluate the potential for, prevalence of, and issues related to the contamination of workers' homes with hazardous chemicals and substances...transported from the workplaces of such workers." With this request, Congress identified a compelling public health issue, bridging health concerns in the workplace and the home. NIOSH found that contamination of workers' homes is a worldwide problem, with incidents reported from 28 countries and from 36 States in the United States. Such incidents have resulted in a wide range of diseases and, in some cases, death among workers' families.

This report represents an important step in addressing the concerns outlined in the Act. It puts us on the road to preventing the exposure of families to potentially harmful substances unknowingly brought home from the job. It also serves as a reminder of the importance of occupational safety and health research to CDC's overall mission of promoting health and quality of life by preventing and controlling disease, injury, and disability.



David Satcher, M.D., Ph.D.
Director, Centers for Disease Control and Prevention

PREFACE

The legislative directive (Public Law 102-522, Section 209, the Workers' Family Protection Act, [29 U.S.C. § 671a]) to conduct this study of contamination of workers' homes by substances carried home on workers' clothing or bodies was enacted on October 26, 1992. However, this is not a new problem. Holt [1923] cited two early studies of lead-workers' families that were published in 1860 and 1896. Oliver [1914] reported on lead poisoning in wives of house painters who washed their husbands' overalls, observations that resulted in a series of laws in Great Britain to protect the workers' families from lead poisoning. Lead poisoning continues to be a problem; this report cites about 65 incidents of lead poisoning among workers' families. Of these, 35 are from the United States, 24 of which were reported in the last 10 years.

Lehmann [1905] reported that the mother and child of a worker exposed to chlorinated hydrocarbons developed chloracne (a condition similar to acne caused by certain chlorinated chemicals) ascribed to the worker's contaminated clothing. Lehmann also wrote of a laundress who developed chloracne as a result of washing the contaminated clothing of workers. Thirty years after Lehmann's report was published in Germany, a similar case was reported by Fulton and Matthews [1936] from the Pennsylvania Department of Labor and Industry. In this case a child's father who was exposed to hexachloronaphthalene and chlorodiphenyl wore his soiled clothing home from work. Additional cases of workers' homes being contaminated with chlorinated hydrocarbons have been reported in the last 10 years.

Prior to 1960, beryllium, toxaphene, mercury vapors, and diethylstilbestrol were also identified as hazards to the families of workers. In the last 10 years, 10 additional chemical substances have been identified in incidents of workers' home contamination, as well as allergens, radioactive materials, and infectious agents.

This report to Congress and the Workers' Family Protection Task Force summarizes the incidents of home contamination this study has discovered, including the health consequences, the sources, and the levels of contamination. The report contains information on the effectiveness of preventive measures and of decontamination procedures that have been used or studied. The report summarizes the relevant laws and regulations and responses of Federal and State agencies and industry to incidents of workers' home contamination.

The report should be useful not only to Congress and the Workers' Family Protection Task Force in deciding future actions, but also to all who have responsibilities and concern for protecting workers and their families from preventable illnesses.

Linda Rosenstock, M.D., M.P.H.
Director, National Institute for Occupational
Safety and Health

EXECUTIVE SUMMARY

The Workers' Family Protection Act of 1992 (Public Law 102-522, 29 U.S.C. § 671a) directed the National Institute for Occupational Safety and Health (NIOSH) to conduct a study of contamination of workers' homes with hazardous chemicals and substances (including infectious agents) transported from the workplace. NIOSH found that contamination of workers' homes is a worldwide problem; incidents have been reported from 28 countries and from 36 States in the United States. Such incidents have resulted in a wide range of health effects and death among workers' families exposed to toxic substances and infectious agents. About half of the reports of health effects have appeared in the last 10 years, revealing new sources of contamination.

In completing the study, NIOSH solicited information from Federal and State health, labor, and environmental agencies, groups with special circumstances such as firefighters, and the public. NIOSH then reviewed and compiled the information received along with information in published reports on contamination of workers' homes by substances brought home from the workplace. The report includes a survey of reported health effects, information on sources and levels of contamination, preventive measures, decontamination procedures, a review of Federal and State laws, and responses of agencies and industry to incidents involving contamination of workers' homes. This report is being considered by the Workers' Family Protection Task Force, which is charged under the Workers' Family Protection Act with evaluating the need for additional research.

Health Effects of Workers' Home Contamination

Workers can inadvertently carry hazardous materials home from work on their clothes, skin, hair, tools, and in their vehicles. As a result, families of these workers have been exposed to hazardous substances and have developed various health effects. Health effects have also occurred when the home and the workplace are not distinct--such as on farms or in homes that involve cottage industries. For some contaminants, there are other potential sources of home contamination such as air and water pollution and deteriorating lead paint in the home. Only a few of the studies found in the literature used epidemiologic methods to estimate the relative risks of health effects from the contaminant transported home by the worker independent of health risks due to other sources of the contaminant in the home.

Little is known of the full range of health effects or the extent to which they occur as a result of workers' home contamination. There are no information systems to enable tracking of illnesses and health conditions resulting from these circumstances. Many of the health effects among workers' family members described below were recognized because of their uniqueness their clear relationship to workplace contaminants, or their serious nature.

- **Chronic beryllium disease**
  This potentially fatal lung disease has occurred in families of workers exposed to beryllium in the nuclear and aviation industries and workplaces involved in the production of beryllium and fluorescent lights and gyroscopes.

- **Asbestosis and mesothelioma**
  Fatal lung diseases have occurred among family members of workers engaged in the manufacture of many products containing asbestos, including thermal insulation materials, asbestos cement, automobile mufflers, shingles, textiles, gas masks, floor tiles, boilers, ovens, and brakeshoes and other friction products for automobiles. Families have also been exposed to asbestos when workers were engaged in mining, shipbuilding, insulating (e.g., pipe laggers and railway workers), maintenance and repair of boilers and vehicles, and asbestos removal operations.

- **Lead poisoning, neurological effects, and mental retardation**
  These health effects have occurred in children of workers engaged in mining, smelting, construction, manufacturing (pottery, ceramics, stained glass, ceramic tiles, electrical components, bullets, and lead batteries), repair and reclamation of lead batteries, repair of radiators, recovery of gold and silver, work on firing ranges, and welding, painting, and splicing of cables.

- **Deaths and neurological effects from pesticides**
  Farm families and families of other workers exposed to pesticides have suffered these serious effects.

- **Chemical burns from caustic substances**
  Chemical burns of the mouth and esophagus and fatalities from ingesting caustic substances have occurred in farm families when hazardous substances were improperly used and stored on farms.

- **Chloracne and other effects from chlorinated hydrocarbons**
  Family members have been exposed when these substances were transported home on clothing of workers manufacturing or using these compounds in the production of insulated wire, plastic products, ion exchange resins, and textiles. Family members have been similarly exposed when workers' clothes became contaminated during marine electrical work, transformer maintenance, municipal sewage treatment, rail transportation, wood treatment, and application of herbicides.

- **Neurological effects from mercury**
  Family members have developed various neurological effects as a result of being exposed to mercury carried home on clothing of workers engaged in mining, thermometer manufacture, and cottage-industry gold extraction.

- **Abnormal development from estrogenic substances**
  Enlarged breasts have occurred in boys and girls and premature menstruation has occurred in girls from estrogenic substances brought home on contaminated clothing of pharmaceutical and farm workers.

- **Asthmatic and allergic reactions from dusts**
  Farm families and others have suffered asthmatic and other allergic effects from animal allergens, mushrooms, grain dust, and platinum salts.

- **Liver angiosarcoma from arsenic**
  Families of workers engaged in mining, smelting, and wood treatment have been exposed to arsenic from contaminated skin and clothing; one child developed liver angiosarcoma.

- **Dermatitis from fibrous glass**
  Family members have developed dermatitis when their clothing was contaminated with fibrous glass during laundering of insulation workers' clothing.

- **Status epilepticus from chemical exposure**
  A child experienced epileptic seizures following ingestion of an explosive compound brought home on the clothing of a worker engaged in the manufacture of explosives.

- **Diseases from infectious agents**
  Family members have contracted infectious diseases such as scabies and Q fever from agents brought home on contaminated clothing and skin of workers engaged in agriculture, hospital, and laboratory work. As intended by Congress, infectious agents are included as hazardous substances to the extent that pathogens can be transported on a worker's person or clothing.

Measures for Preventing Home Contamination

Preventive measures that were found to be effective when used in the workplace include:

- Reducing exposures in the workplace;
- Changing clothes before going home and leaving the soiled clothing at work to be laundered by the employer;
- Storing street clothes in separate areas of the workplace to prevent their contamination;
- Showering before leaving work; and
- Prohibiting removal of toxic substances or contaminated items from the workplace.

Preventive measures that have been used successfully at home include:

- Separating work areas of cottage industries from living areas;
- Properly storing and disposing of toxic substances on farms and in cottage industries;

- Preventing family members from visiting the workplace;
- Laundering contaminated clothing separately from family laundry when it is necessary to launder contaminated clothing at home; and
- Informing workers of the risk to family members and of preventive measures.

Other preventive measures that need to be used include:

- Educating physicians and other health professionals to inquire about potential work-related causes of disease;
- Developing surveillance programs to track health effects that could be related to home contamination; and
- Educating children, parents, and teachers about the effects of toxic substances.

Procedures for Decontaminating Homes and Clothing

Decontamination procedures include air showers, laundering, airing, vacuuming and other methods of surface cleaning, and destruction and disposal of contaminated items. These procedures appear to have widely varying effectiveness, depending on the specific methods employed, the contaminants, and the surfaces. In general, hard surfaces can be far more easily decontaminated than clothes, carpets, and soft furniture. In most cases effective decontamination requires relatively intensive methods. Normal house cleaning and laundry practices appear to be inadequate for decontaminating workers' clothes and homes. Lead, asbestos, pesticides, and beryllium contamination can be especially persistent. In some instances even intensive decontamination procedures may be ineffective.

Another serious concern is that decontamination methods can increase the hazard to the person performing the operation and to others in the household. Home laundering of contaminated clothing exposes the launderer. Vacuuming of floors contaminated with mercury can substantially increase air concentrations, and vacuuming of carpets contaminated with lead can increase lead concentrations on the carpet surface.

The difficulty of decontaminating work clothing, the prominence of clothing as a source of home contamination, and the potential exposure of the launderer are problems that can be avoided through the use of disposable work clothing. The use, availability, and cost of this alternative need to be assessed.

Federal and State Laws

Seven statutes provide Federal agencies with some mechanisms for responding to or preventing workers' home contamination. Twenty rules or standards in the Code of Federal Regulations (CFR) address workers' home contamination or have elements that serve to protect workers' families.

Under the Occupational Safety and Health Act of 1970 (Public Law 91-596), NIOSH research assessing the health of workers has also addressed the exposure of their families to workplace contaminants, resulting in recommendations to prevent home contamination. The Occupational Safety and Health Administration (OSHA) regulations and actions intended to protect workers also help assure that families are protected. In addition, OSHA can promulgate standards to protect workers' family members when workers are required to live in housing provided by the employer as a condition of employment. Under the Federal Mine Safety and Health Act of 1977 (Public Law 95-164), the Mine Safety and Health Administration (MSHA) has limited regulatory authority to address issues of workers' home contamination.

The U.S. Environmental Protection Agency (EPA) has broad authority under the Toxic Substances Control Act (Public Law 94-469) to regulate chemicals and to obtain information about the adverse effects of chemicals. In addition, EPA has specific authority and responsibility regarding the use of asbestos and lead. Under the Federal Insecticide, Fungicide, and Rodenticide Act (Public Law 92-516), EPA also regulates the use and disposal of pesticides (which also helps to protect workers' families). EPA and the Agency for Toxic Substances and Disease Registry (ATSDR) are authorized under the Superfund Amendments and Reauthorization Act of 1986 (Public Law 99-499) to address hazardous waste and releases of hazardous substances that may relate to identifying contamination of workers' homes and assuring decontamination.

Thirty States and Puerto Rico responded to the requests from NIOSH for information about State laws. Most indicated that there were no laws specific to workers' home contamination or protection of workers' family members. Some States identified laws requiring the reporting of cases of elevated blood lead levels and pesticide poisonings to a State agency; other States identified laws related to work at hazardous waste sites and emergency responses to releases of hazardous substances. An examination of occupational safety and health regulations of States with OSHA-approved occupational safety and health programs revealed none more stringent than Federal OSHA regulations - with respect to the protection of workers' families. However, extension of occupational safety and health regulations to State and local government employees in these States also helps protect the families of public employees' in these States.

Responses to Incidents of Workers' Home Contamination

Several Federal agencies have responded to incidents of workers' home contamination, often working together with State or local government agencies. These responses have resulted in identification of workers' home contamination, decontamination of workers' homes, and recommendations for instituting workplace changes that would prevent further contamination. NIOSH has conducted approximately 40 health hazard evaluations that address potential home contamination. In several cases, Federal agencies have referred incidents to State or local health departments for follow-up actions.

State agencies have investigated incidents of workers' home contamination, made referrals to Federal agencies for follow-up actions, and recommended workplace improvements to prevent further contamination of workers' homes.

Responses to incidents of workers' home contamination include educational materials such as those of the Lead Industries Association, Inc. on preventing workers' home contamination as well as responses of various employers to specific incidents of home contamination.

Limitations of the Report

The health information available for the report, which includes incidents of illness and home contamination obtained from public agencies and published literature, does not provide a basis for estimating the prevalence of this public health problem.

The Workers' Family Protection Act requires NIOSH to evaluate relevant information about indoor air quality as it relates to workers' home contamination and to study the special circumstances of firefighters as they relate to contamination of their homes.

- The only report found on indoor air quality applicable to workers' family protection involved tetrachloroethylene exposures in living quarters located in the same building as dry-cleaning establishments. Indoor air quality studies would be useful to protect family members in cottage industries.

- Incidents of contamination of firefighters' homes were not identified. However, NIOSH has conducted several studies of contamination and decontamination of protective clothing used by firefighters. These studies are reviewed in this report and NIOSH will continue to pursue the issues related to potential contamination of firefighters' homes.

Other limitations of the report include:

- Little research has documented the frequency and distribution of health effects among the families of workers in various industries and occupations. NIOSH is undertaking one study addressing lead exposure among families of bridge repair workers.

- Lead and pesticides are the only contaminants for which monitoring or reporting programs help to identify and prevent cases of poisoning from workers' home contamination.

- Despite various case reports, the prevalence of health effects from workers' home contamination is not known because there are no surveillance systems in place for tracking or monitoring such health conditions.

- Many diseases have long latency periods between exposure and manifestation of the disease, making identification and intervention difficult.

- The workplace origin of many common diseases that occur in workers' families (such as asthma, dermatitis, and infectious diseases) is probably unrecognized because physicians and other health professionals fail to inquire about the occupation of family members and to consider whether these diseases are work-related.

- The literature reviewed in this report contained only nominal information about contamination levels in workers' homes. Most measurements were of surface dust, for which there are no guidelines for acceptable levels of contamination.

Recommendations for Research and Education

- The prevalence of health effects of contaminants transported from the workplace should be determined. One possible approach would be to conduct surveys among occupational and environmental medicine health care providers and clinics.

- The employment practices and controls that work best in preventing the transport of contaminants from the workplace to the home should be identified.

- Educational programs to prevent home contamination should be developed for employers, workers, children, teachers, and parents, physicians, and other health professionals.

- The special needs and problems of individuals who work in home or cottage industries need to be identified.

Conclusions

- Workers' home contamination may pose a serious public health problem. Health effects and deaths from contaminants brought home from the workplace have been reported in 28 countries and 36 States.

- The extent to which these health effects occur is not known because there are no information systems to track them, and physicians do not always recognize the occupational contribution to various common diseases.

- About half of the reports of health effects from home contamination are less than 10 years old. The literature on the health effects involved approximately 30 different substances or agents. The potential exists for many of the thousands of other chemicals used in commerce to be transported to workers' homes or to be used in home-centered businesses.

- Health effects and deaths from contaminants brought home from the workplace are preventable using known effective measures. Educational programs are needed to promote their use.

- Normal house cleaning and laundry practices are often inadequate for decontaminating workers' homes and clothing and can increase the hazard to the person performing the tasks and others in the household.

- Only two Federal laws have elements that directly address workers' home contamination. However, other laws provide agencies with certain mechanisms for responding to, or preventing workers' home contamination. Operating under existing laws OSHA, MSHA, DOE, ATSDR, EPA, and CDC, including NIOSH and the National Center for Environmental Health have responded to incidents of workers' home contamination, made recommendations to prevent such incidents, and conducted relevant research.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLES

TABLES

APPENDICES

INTRODUCTION

Because of repeated reports of contamination of workers' homes in their States, identical bills [WFPA 1991a], S. 353 [WFPA 1991b] and H.R. 845 [WFPA 1991c], were introduced in 1991 by Mr. Jeffords (Vermont) and Mr. Ballenger (North Carolina) in the U.S. Senate and the U.S. House of Representatives, respectively. The Senate Subcommittee on Labor of the Committee on Labor and Human Resources held a hearing on S. 353 on July 26, 1991 [U.S. Senate 1991a]. Following the hearing, the Committee on Labor and Human Resources revised S. 353 and issued a report on November 27, recommending the revised bill to the Senate [U.S. Senate 1991b]. The revised bill was incorporated into the Fire Administration Authorization Act of 1992 (Public Law 102-522) as Section 209 of that law, which was enacted on October 26, 1992. Section 209, the Workers' Family Protection Act, appears in the United States Code at 29 U.S.C.[1] § 671a (Appendix 1).

The Workers' Family Protection Act requires the National Institute for Occupational Safety and Health (NIOSH) to conduct a study on workers' home contamination in cooperation with the Secretary of Labor, the Administrator of the Environmental Protection Agency, the Administrator of the Agency for Toxic Substances and Disease Registry and other appropriate Federal Government agencies. The purpose of the study is to evaluate contamination of workers' homes with hazardous chemicals and substances, including infectious agents, transported from the workplaces. The study is to consist of: (1) a review of past incidents of home contamination reported in the literature and in the records of NIOSH, the Occupational Safety and Health Administration (OSHA), the States, and other governmental agencies, including the Department of Energy (DOE) and the Environmental Protection Agency (EPA); and (2) an evaluation of current statutory, regulatory, and voluntary industrial hygiene or other measures used by small, medium, and large employers to prevent or remediate home contamination.

The Act directs NIOSH to report existing research and case histories conducted on incidents of employee transported contaminant releases, including:

- The health effects, if any, of the resulting exposure on workers and their families;
- Methods for differentiating exposure health effects and relative risks associated with specific agents from other sources of exposure inside and outside the home;
- The effectiveness of workplace housekeeping practices and personal protective equipment in preventing home contamination;
- The effectiveness of normal house cleaning and laundry procedures for decontaminating workers' homes and personal clothing; and
- Indoor air quality, as the research concerning such pertains to the fate of chemicals transported from a workplace into the home environment.

---

[1]United States Code.

In conducting the study and preparing the report, NIOSH has taken a broad approach to the problem of workers' home contamination in order to ensure that relevant information is included. Some reports that may relate to hobbies were included because the distinction between hobby and "cottage industry" is not always clear and the situations may be similar. Reports where family members were exposed by visiting the workplace were included, as were reports where living quarters adjacent to workplaces were contaminated. Studies of contamination of homes from other sources were included if they provided relevant information about levels of contamination, methods of measurement, or decontamination. As intended by Congress, infectious agents are included as hazardous substances to the extent that pathogens can be transported on a worker's person or clothing. Congress did not intend for the Workers' Family Protection Act to apply to the spread of infectious diseases by other means.

In July 1993, a working group was formed with representatives from each NIOSH Division to plan and implement a strategy to conduct this study. Specific task areas were assigned to members of this working group. Several Federal agencies including the Agency for Toxic Substances and Disease Registry (ATSDR), the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Department of Energy (DOE), the Mine Safety and Health Administration (MSHA), and the Centers for Disease Control and Prevention (CDC) provided assistance in conducting the study.

The NIOSH working group obtained information for this report through a variety of routes. On November 15, 1993, a notice entitled "National Institute for Occupational Safety and Health: Request for Existing Information Relevant to Implementing the Workers' Family Protection Act" was published in the Federal Register (Appendix 2). The notice requested information on several topics including measurements of home contamination, reports on government actions occurring as a result of home contamination incidents, preventive measures used by employers, and effectiveness of industrial hygiene practices. This notice was announced in CDC's Morbidity and Mortality Weekly Report (MMWR) on December 10, 1993 (Appendix 2), by electronic mail to State agencies involved in NIOSH occupational health programs and cooperative agreements and to county agriculture extension agents. A request for information was also distributed to Poison Control Centers.

In January 1994, NIOSH sent over 1,100 letters to associations and State and Federal agencies and programs requesting information relevant to this study. The Federal Register Notice was enclosed with these letters. The mailing lists used and copies of written responses are available from the NIOSH Docket Office.

Over 50 written and several telephone responses were received. Working group members followed up on several Federal, State, and local agency responses. All State-plan occupational safety and health offices were contacted by telephone to obtain a copy of relevant State laws on occupational safety and health.

Several previous review articles provided an entry to the world literature [Bellin 1981; Chisolm 1978; Lehmann 1977; McDiarmid and Weaver 1993].

Key-word literature searches were conducted in various databases, including TOXLINE and NIOSHTIC. Articles and reports identified in these searches were obtained and reviewed for relevance. In most cases, cited references from these reports and articles were retrieved and reviewed as well.

The report is arranged to address the issues identified in the Act. In Chapter 1, the studies relating to health effects are reviewed. Details of the studies for each contaminant are presented in Tables 1-14 and overviews of the findings for each contaminant are presented in the text. In Chapter 2, the sources of contamination are discussed by contaminant, where information was available. Chapters 3, 4, and 5 present discussions of the studies for each contaminant on: levels of contamination; preventive measures; and procedures for decontamination, respectively. Table 15 presents the details on industrial hygiene studies cited in Chapters 2-5 by contaminant, incorporating the process, the industrial hygiene methodology, observations, and comments or recommendations. Studies on laundry procedures for pesticides which are discussed in Chapter 5 are summarized in Table 16.

In Chapter 6, Federal and State laws that are operative are discussed. The Federal statutes are summarized in Table 17 and rules of various Federal agencies found in the Code of Federal Regulations are tabulated and explained in Table 18. In Chapter 7, the responses of Federal and State agencies and industry to incidents of home contamination are reviewed; these are summarized in Tables 19-23.