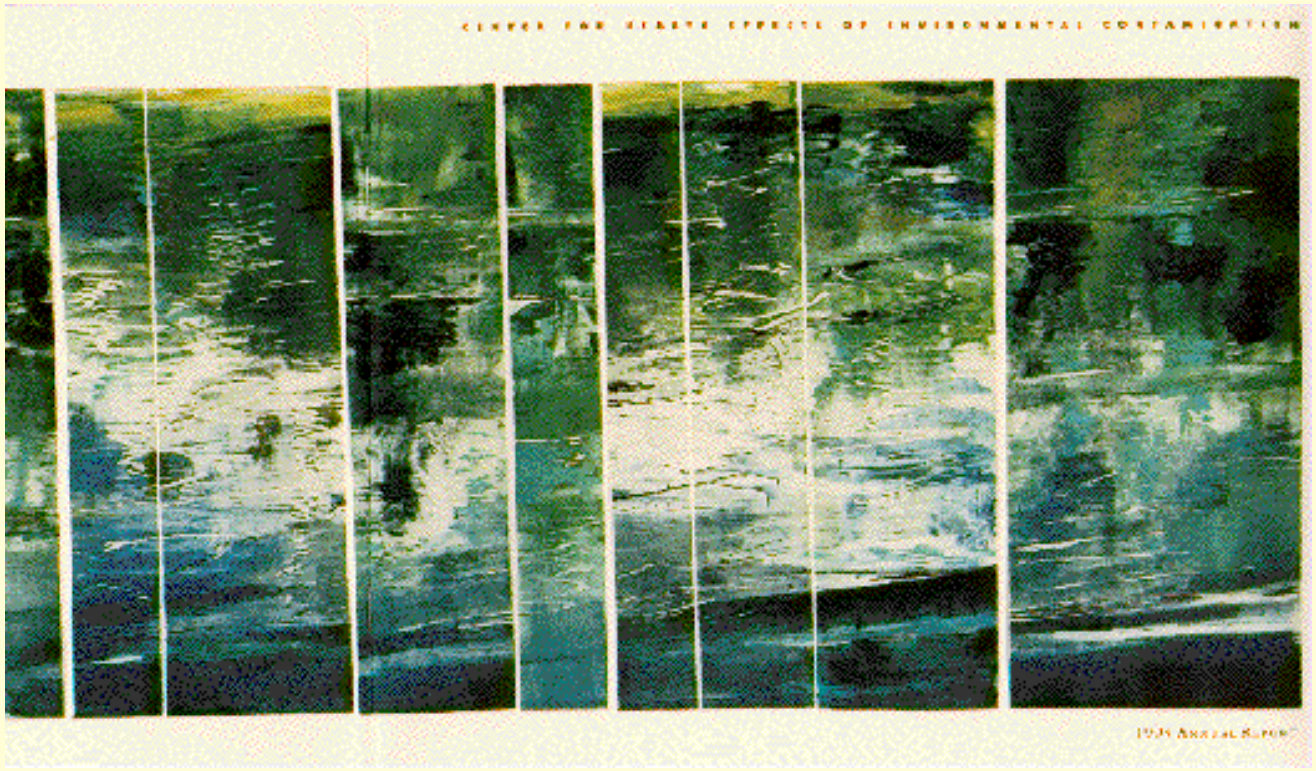
Center for Health Effects of Environmental Contamination | CHEEC

1993 Annual Report



The 1993 Annual Report of the Center for Health Effects of Environmental Contamination spotlights activities of the CHEEC Data Management Center (CDMC), presents summaries of pilot studies which were awarded CHEEC seed grants during 1993, and describes the Center's ongoing educational programs.

The CDMC was established to work on a number of objectives outlined in the 1987 Iowa Groundwater Protection Act. First and foremost among these was identifying and compiling Iowa municipal water supply data which could be used to study exposures to drinking water contaminants and possible health effects. In June, 1993, the CDMC published the 2nd edition of *Historical Community Water Supply and Treatment Data for the State of Iowa*, which presents information from what has become the definitive database on Iowa municipal water supplies. These data are used in descriptive and analytical epidemiologic studies primarily related to cancer and birth defects.

The CDMC plays a vital role in CHEEC's efforts towards accomplishing several legislative goals. The goals are highlighted in this Annual Report and specific activities undertaken to achieve those goals are discussed. Over the past two years, the CDMC staff has grown and the data management activities of CHEEC have increased dramatically. Staff regularly attend classes on subjects such as relational database design and management, systems support and statistical analyses in order to stay current with the ever increasing complexity of PC-based systems. Because of the high level of expertise of the CDMC staff, CHEEC has been able to assimilate a wide variety of data into its environmental databases. Recently, the experience of the CDMC staff has led to their direct involvement in studies relating environmental exposures to health outcomes. Project overviews and CDMC support efforts are described on the pages which follow.

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Data Management Center

The CHEEC Data Management Center (CDMC) has a staff of three full time database analysts who provide full support for systems programming, network administration, database design and administration and applications development and also respond to request for information from academia, regulatory agencies, the private sector and the public. Environmental databases are designed and managed on the ORACLE Database Management System (DBMS).

Environmental Databases

The CDMC was established in response to several water quality research needs described in the 1987 Iowa Groundwater Protection Act. The Act outlined various activities which the Center could pursue within the broad scope of its overall mission. Initially, CHEEC was instructed to *"...assemble all existing data relating to Iowa drinking water supplies, including characteristics of source, treatment, presence of contaminants, precise location and usage patterns to facilitate data retrieval and use in research."*

In response to this mandate, CHEEC began work developing a number of environmental databases. The CDMC has been very successful identifying and accumulating municipal water supply information from a variety of sources, and has developed the definitive database of water source information and treatment characteristics for Iowa municipal water supplies serving communities with a population of 400 or more.

In 1993, the 2nd edition of *Historical Community Water Supply and Treatment Data for the State of Iowa* was published and widely distributed. This monograph is a compilation of previous reports (1st edition - 1990; aquifer data - 1992) with information current through 1992. Updates and additions to the database were acquired from telephone interviews with water plants operators; aquifer information and local well names were supplied by the Iowa Department of Natural Resources-Geological Survey Bureau (IDNR-GSB). These data are being used by researches who are studying drinking water contaminants, both natural and man-made, and their possible relationship to the development to diseases.

CHEEC provided funding for the IDNR-GSB to develop the Iowa Municipal Water Supply Inventory Well Identification Table (WIT), an inventory of municipal water supply sites with cross references to identifiers used by the University Hygienic Laboratory (UHL), IDNR and CHEEC. The WIT is a dynamic document which can be changed as new information becomes available. The WIT has been integrated into the Historical Community Water Supply and Treatment Database which is sorted in relational tables on the CHEEC ORACLE Server. CDMC and IDNR-GSB staff work cooperatively to update the CHEEC database for well nomenclature, well identification and well status. IDNR-GSB staff may access the tables from their offices via network connections.

The Statewide Rural Well Water Survey (SWRL) database is also maintained by the CDMC. SWRL was conducted in 1988-89 as a collaborative effort by CHEEC and IDNR. SWRL data provide a "snapshot" view of the extent of bacteria, nitrate and pesticide contamination in a large sample of Iowa's private rural wells. SWRL results have been used to develop several studies on rural well contamination and provided evidence substantiating public concern regarding pervasive groundwater contamination from agricultural chemicals in the Midwest. Data from the 1989 Iowa Rural Radon Gas Survey are also a component of the CDMC environmental databases. This project utilized a subset of the SWRL population to determine radon levels in private rural water supplies and in the homes using those water sources for drinking.

Analytical information on the CDMC database includes the 1986-87 One-Time Testing of Iowa's Regulated Drinking Water Supplies (HF 2303), the 1987 National Cancer Institute-Environmental Protection Agency Municipal Water Supply Survey, raw and finished municipal water quality data from the USGS QWDATA system and the USGS WATSTORE file, historical raw and finished water quality data from the UHL and finished water quality data from a 1979 National Survey of Environment and Health.

Health Effects Research: Retrospective Studies

The Groundwater Protection Act states that CHEEC may *"...make use of data from the existing cancer and birth defect statewide recording systems and develop similar recording systems for specific organ diseases which are suspected to be caused by exposure to environmental toxins."*

CHEEC works closely with the State Health Registry of Iowa and the Iowa Birth Defects Registry, Iowa's population-based cancer and birth defects registration systems. CHEEC researchers have conducted aggregate statistical studies of the incidence of various

cancers as well as the incidence of several categories of birth defects in relationship to community source of drinking water supply, treatment characteristics and various contaminant levels. These preliminary studies are undertaken to determine if more thorough investigations are needed. The CDMC provided computer applications and systems support for this environmental health research.

A current in-house study involves looking at the types of water softening processes used by municipal treatment plants to see if there may be any connection between water softening/water hardness and mortality rates from heart disease. A recent Swedish study documented a statistically significant inverse relationship between the level of hardness (measured as calcium carbonate: CaCO3) in drinking water and age-adjusted mortality rates from heart disease for both sexes; magnesium content appeared to play a role in protecting against heart disease. In the U.S. as well as in Europe, there is evidence that areas served by soft waters usually show higher rates of cardiovascular mortality than areas served by hard water. CHEEC researchers are examining community mortality rates of heart disease in Iowa to see if there might be any relationship to the type of municipal softening treatment in use. The hypothesis is that water treated by ion exchange (which substitutes sodium for magnesium and calcium) might put the user at an increased risk of developing heart disease compared to water treated with other softening processes which do not introduce sodium, or compared to water that receives no softening treatment.

Another in-house study involves determining lifetime fluoride exposure from drinking water. This is being done by linking residential information on participants in the Case-Control Study of Cancer and Drinking Water Contaminants (University of Iowa Department of Preventive Medicine and Environmental Health, 1986-1990) to fluoride analysis information within the CHEEC environmental database. These linked data are used to compute exposures to fluoride from primary drinking water sources. Exposure estimates are computed one person at a time; for persons obtaining their primary drinking water from a community supply, the linkage is performed at the water source level within the community. Within the CHEEC environmental database, the following data exists for community water: 1) aquifer information, 2) the years the specified water source began and ended supplying drinking water to the community at a specified percentage, and 3) the years artificial fluoridation began and ended. Historical water sample analyses where natural fluoride measurements were made have been previously linked to a source. By linking this information with residential history information it has been possible to assign a lifetime fluoride exposure for study participants.

The CDMC provides database administration and systems support for the Residential Radon and Lung Cancer Case-Control Study being conducted by the UI Department of Preventive Medicine and Environmental Health in collaboration with the Department of

Preventive Medicine at the University of Kansas Medical Center. The project has been set up at The University of Iowa as a cooperative effort between the Department of Preventive Medicine, the CDMC and the State Health Registry of Iowa. The study's main objective is to evaluate the association between residential radon exposure and the incidence of lung cancer in Iowa women. Advisories have been issued indicating radon is the second leading risk factor for lung cancer and may be responsible for 7,000 to 30,000 lung cancer deaths annually. In this study approximately 600 cases and 600 controls between the ages of 40 and 84 will be identified and interviewed, and radon exposure assessments will be taken in subject homes. The five year project is being funded by a grant from the National Institute of Environmental Health Sciences.

Health Effects Research: Prospective Studies

CHEEC may *"...develop registries of persons known to be exposed to environmental hazards so that the health status of these persons may be examined over time."*

Full computer support including database design and administration, system services and applications programming are being provided by the CDMC for the Agricultural Health Study being conducted in Iowa by the UI Department of Preventive Medicine and Environmental Health. The study is also being conducted in North Carolina by Survey Research Associates, Inc. The goal of the study is to create a large cohort (approximately 100,000 persons) that can be followed for 10 years or more to obtain detailed information on agricultural exposures, diet, cooking practices and other factors which may be related to the development of cancer and other diseases.

Working through the Pesticide Applicator Certification Testing Program of the Iowa Department of Agriculture and Land Stewardship and the Pesticide Applicator Certification Training Program of the Iowa State University Cooperative Extension Service, researches plan to enroll 39,000 farm owner/operators (private pesticide applicators), 8,000 commercial applicators, and 28,000 spouses of private applicators during the first five years of the study. An estimated 20,000 persons will be asked to participate in North Carolina. Information from these two states will provide data on agricultural practices that can be helpful to farmers nationwide. The study is being jointly funded by the National Cancer Institute, the Environmental Protection Agency and the National Institute of Environmental Health Sciences.

CDMC staff developed an integrated computer system to support the study's activities. The team of researchers and administrative staff rely heavily on the system to support the enrollment process and track enrollment progress. From a systems point of view, it is a unique project because data must be shared between different agencies involved in the study and the high volume during peak enrollment period places a great demand on system resources. CDMC's major contribution to the Agricultural Health Study has been the design and implementation of all computer applications involved in the study protocol, which involves a complex series of procedures designed to ensure that both the maximum number of participants are enrolled and followed and that rigid quality control can be maintained. It includes an inventory tracking system, an enrollment scheduling and tracking system, a data entry system, a mailing system and the cohort database.

In order to provide for the study's needs, CDMC built a 20 node Local Area Network (LAN) at Oakdale Hall on the Oakdale Campus of The University of Iowa. The network profiles access to the CHEEC ORACLE Server, the State Health Registry's ORACLE Server, the Internet global network, CCMAIL electronic mail system and a handful of desktop software packages such as the Lotus SmartSuite and WordPerfect. The network includes a Novell NetWare file server, the ORACLE Server for NetWare, and OS/2 FTP file server for sending and receiving data on the Internet and a number of user workstations. CDMC staff developed the data management budget and schedule, installed the LAN, designed the database, created numerous data entry forms and wrote a number of applications for tracking the progress and quality of the enrollment function.

Technology and Future Applications

CHEEC may *"...assemble all pertinent laboratory data on the presence and concentration of contaminants in the soil, air, water and food, and develop data retrieval systems to allow the findings to be easily correlated with existing health outcomes."*

CDMC staff are working with researchers at Iowa State University to integrate environmental exposure data within a Geographic Information System (GIS) in order to link those data to health outcome data (see "Seed Grant Program"). This will be a cooperative effort between CHEEC, the Department of Agricultural and Biosystems Engineering at ISU, IDNR-GSB and the State Health Registry of Iowa. The intent is to include available information on pesticide and other contaminant in soils for defined geographic regions and in community water supplies on a source-specific basis. If the GIS prototype developed by this project is successful, it can be used for a wide variety of research applications which are of interest to CHEEC as well as to other environmental research groups in Iowa.

CDMC staff are also working with UHL data processing staff to acquire analytical water quality data for Iowa municipal water supplies on a regular basis. As described previously, the CHEEC database contains historical information from a number of sources. By working cooperatively with the UHL, more recent and current analytical information can be accessed to identify specific contaminants and variations in contaminant levels, in order to determine population exposures over time.

In an effort to facilitate environmental research efforts involving health outcome and exposure data linkages, CDMC staff have created a geographic code database (ATLAS) and a tracking system (SPLATS) which can be used in the daily operations of a study. ATLAS was designed as a cooperative effort between the CDMC, the State Health Registry of Iowa and the Iowa Birth Defects Registry. In the past, sharing data between these groups has been hindered by a lack of uniformity in the coding schemes they used. With the formation of the ATLAS database, linkage between studies based on geographic information can be done easily and reliably. ATLAS consists of a dozen tables containing codes and descriptive information about countries, U.S. states, counties, cities and zip codes. ATLAS also contains population information for Iowa communities and counties from the 1970, 1980 and 1990 censuses.

SPLATS (Systematic Procedure for Labeling and Tracking Samples) is a tracking system developed by CDMC for use in studies that require sampling the environment. It resulted from a dissatisfaction with manual methods of sample tracking that were prone to error and did not adequately keep tabs on samples once they had been sent to a laboratory for analysis. SPLATS was designed to be used by CHEEC in its various studies of water contamination in Iowa. CHEEC is committed to the ORACLE DBMS, however, any robust relational database management system could also be used to effectively implement SPLATS.

Seed Grant Program

Since the fall of 1988, the CHEEC Seed Grant Program has funded 41 pilot studies on exposure or risk assessment of environmental contaminants. The following projects were awarded seed grants during 1993.

A historical cohort study of cancer among urban vs. rural residents and farmers vs. non-farmers in Iowa.

Investigators: CF Lynch, H Song; Department of Preventive Medicine and Environmental Health, The University of Iowa
Summary: Despite the fact that rural residents and farmers have a lower overall cancer mortality rate, studies have shown that they have elevated incidence and mortality rates for Hodgkin's disease, leukemia, non-Hodgkin's lymphoma, multiple myeloma and other cancers. The factors that contribute to these excesses in rural and agricultural environments are not well understood. This study will use existing exposure data on control subjects from previous population-based cancer case-control studies in Iowa to calculate cancer incidence rates for urban vs. rural residents and farmers vs. non-farmers, determine incidence rates for "farming-related" cancers and evaluate how possible confounding variables, such as consumption of alcohol and tobacco, may contribute to the lower cancer incidence rates among rural residents and farmers.

A preliminary study of temporal variable of 222Radon in rural community water supplies

Investigators: EL Fisher, LJ Fuortes; Department of Preventive Medicine and Environmental Health, The University of Iowa
Summary: Seasonal and short-term temporal variations of radon suggest that one-time sampling of water supplies may not produce a representative sample of well water. Obtaining concentration levels of water supplies at or near the proposed U.S. EPA Maximum Contaminant Level is complicated by these variations. The aims of this research are to determine temporal variations in 222Radon in community water supplies looking specifically at water use, temperature, precipitation, and barometric pressure; determine the relationship between raw and finished water 222Radon concentrations over time in water supplies where 222Radon in finished water exceeds that in raw water; and propose a sampling scheme which will provide a representative 222Radon water concentration.

Assessment of exposures to bioaerosols among Midwest farmers - effects of flooding

Investigators: PS Thorne, N Lynch, J Lange, J DeKoster; Institute of Agricultural Medicine and Occupational Health, The University of Iowa
Summary: One of the major risk factors for morbidity faced by farmers is pulmonary injury due to inhalation of microorganisms and their metabolites, which are responsible for causing farmer's lung, organic dust toxics syndrome, acute airways inflammation and asthma in farmers. In most cases microbial viability is not a requirement for toxicity. Exposures to bacterial and fungal bioaerosols can reach very high levels when feed or stored animal bedding materials are substandard due to excess moisture content. Conventional wisdom suggests that "moldy" hay, corn and soybeans will be major problems in a wet year, particularly from the standpoint of the suitability of those crops for animal feed. However, it is unknown whether flooding and wet storage conditions lead to significantly higher bioaerosol exposures among farmers. The purpose of this project is to determine if the flooding and wet conditions of 1993 will result in significantly greater risk for pulmonary injury, due to bioaerosol exposures that are significantly higher than those measured in environments unaffected by the flooding.

Air quality studies and health assessments of individuals living in the vicinity of swine confinement operations

Investigators: KH Donham, KM Thu, PS Thorne, SJ Reynolds; Institute of Agricultural Medicine and Occupational Health, The University of Iowa
Summary: Several key issues have come together to create one of the most contentious issues Iowa agriculture has faced. These include the growth of new intensive agricultural production systems, public concern about the environment and questions about the health of the farm population. Nowhere is the more evident than swine production. The problem Iowa faces is how to enhance swine production, maintain environmental quality and sustain the health of its rural residents. This study will provide needed information to help meet this challenge. A good base of knowledge exists on how to control health hazards to workers in swine confinement buildings. The next challenge is to define and control health and environmental hazards outside the building. This project focuses on health hazards of air contaminants to persons living in the vicinity of large swine confinement production units. The nature of complaints and symptoms residents have will be systematically studied, air quality (aerosolized dust, endotoxin, ammonia, and hydrogen sulfide) in the vicinity of buildings will be assessed and associations between exposures and symptoms investigated.

Exploratory studies of the effects of corrosion control strategies on radium accumulation in distribution system deposits and radon release into drinking water

Investigator: RL Valentine; Department of Civil and Environmental Engineering, The University of Iowa
Summary: Radon formation from radium containing deposits in distribution systems could limit the ability of a utility to meet desired radon levels and would complicate treatment/mitigation approaches mandated by pending EPA radionuclides regulations. Corrosion control strategies are being adopted by many utilities facing new regulation for copper and lead which will likely affect radium deposition and radon release into distribution systems. This project will scope out the potential significance of several corrosion control strategies and changes in water quality on the formation of radium bearing deposits and radon release from them. Batch and pipe loop studies will be conducted and changes in radon release rates and radium accumulation in deposits measured. The chemical composition and nature of deposits will also be examined.

Development of a database to accommodate management of exposure and environmental data within a Geographic Information System

Investigator: US Tim; Department of Agricultural and Biosystems Engineering, Iowa State University
Summary: Computer-based data management systems will be used in research testing the hypothesis that the potential for human exposure to pesticides varies regionally and with land use. To study possible human health risks posed by pesticides in Iowa's drinking water supplies, information is needed regarding the spatial extent and magnitude of the contamination and the exposed population. Much of the available information on pesticide pollution is in the form of tabular summaries and spreadsheets. In Iowa, many types of human health effects data are maintained on computerized databases. It is important that these data be compiled into a common format in order to make accurate observations and informed decisions. This project will develop a computer-based prototype system consisting of a database management system and geographic information system for recording, processing, and displaying spatial, analytical, environmental and human exposure data collected in Iowa. The various modules of the system will allow the user to enter or retrieve data, prepare standard and ad hoc reports and generate maps for risk analysis and decision making.

Synthetic soils from industrial wastes, Phase II: health-related analysis of leachates and crops

Investigators: L Drake, K Krupp; Department of Geology, The University of Iowa
Summary: Cities and industries produce large quantities of bulk wastes such as fly ash and bottom ash (power plants), lime sludge (water and stack treatment facilities), sewage sludge and landfill compost. While much of this material is non-hazardous, it has no commercial value and is looked at as a waste in need of disposal. Many experiments demonstrate that bulk industrial wastes can be land applied with little detriment to soils or human health. However, constraints are sufficiently restrictive that most of these wastes are sent to landfills. This project seeks to determine whether synthetic soils can be blended entirely from these wastes and examines the potential chemical effects upon water quality, wildlife, agriculture and human health risks. If successful, these soils could be useful for reclaiming abandoned strip mines, covering landfills and restoring derelict land. Phase I of the study has shown that plants can be grown in totally synthetic soils. Phase II will involve creating synthetic soils and performing chemical analyses from bulk wastes in south central Iowa with the intent of using the resultant soils for strip mine reclamation in that area. The chemical analysis will emphasize the leachability of heavy metals and other substances inimical to human health.

The use of vegetation to enhance bioremediation of soils in Iowa contaminated with pesticide wastes

Investigators: JR Coats, TA Anderson; Pesticide Toxicology Laboratory, Department of Entomology, Iowa State University
Summary: Several studies report that plant roots in conjunction with their associated microbial communities offer a potentially valuable treatment strategy for in situ biological remediation of chemically contaminated soils. These findings are important because vegetation may provide a low-cost alternative of supplement to expensive, capital-intensive technologies for soil cleanup. This project will look at whether vegetation can have a positive effect on microbial degradation of pesticide wastes in soils as a result of the rhizosphere effect. The primary objective is to determine the role of herbicide-tolerant plants and commodity plants in facilitating microbial degradation of herbicide wastes in soils. This information can then be used in defining the potential role of vegetation, under specific types of chemical contamination (herbicides, insecticides, industrial chemicals) in the bioremediation process. The potential reduction in transport and movement of contaminants off-site will significantly decrease the potential human health concerns for these chemicals at waste sites by minimizing human exposure through drinking water as well as through the aquatic food chain.

Education

CHEEC participated in the 1993 Farm Progress Show held in Amana, Iowa, as part of the University of Iowa exhibit "Health Resources for Rural Iowa." A display presented information on environmental health research in rural populations and staff were on hand to answer questions and visit with persons attending the Show. Information on programs and research was on display at the Iowa State Fair and several talks on Center activities were given on-campus. In addition, presentations were made to legislative committees in both Iowa and Minnesota during 1993. A newsletter was developed and distributed widely across the state. The first issue focused on health concerns related to the 1993 flood particularly with respect to possible chronic diseases following long-term, low level exposures to water contaminants, and potential indoor air problems.

The following seminars were sponsored by CHEEC during 1993:

Ozone and ultraviolet radiation: the implications of trends on UV-B exposure
Gregory Carmichael, Professor and Chair, Department of Chemical and Biochemical Engineering, The University of Iowa

Environmental factors associated with radon in rural Iowa homes
LeAnn Weih, Department of Preventive Medicine and Environmental Health, The University of Iowa

Water chlorination by-products and cancer in Iowa
Kenneth Cantor, Environmental Epidemiology Branch, Division of Cancer Etiology, National Cancer Institute

Source of drinking water and cancer incidence in Iowa
Charles Lynch, Associate Professor, Department of Preventive Medicine and Environmental Health, The University of Iowa

Association of intrauterine growth retardation with chloroform in drinking water
Michael Kramer, Allergy and Pulmonary Division, Department of Pediatrics, University of Iowa Hospitals & Clinics

Farm exposures and female infertility in Iowa
Kathy Clark, Assistant Professor, College of Nursing, The University of Iowa

Environmental policy: current and future priorities
David Osterberg, State Representative, Mt. Vernon, Iowa; ranking member, House Committee on Energy and Environmental Protection

CHEEC responded to information requests from Iowa legislators, state agencies and county health departments, the Environmental Protection Agency, health departments in Michigan, Minnesota and Texas, the Iowa Farm Bureau, the Easter Seal Society, the State Council of Governments, water treatment plant operators, university researchers and students, engineering consulting firms, environmental activist groups and the general public.

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