

## 1997 Project Abstract

For the Period Ending June 30, 1999

This project was supported by MN Future Resources Fund (MS 116P.13)

**TITLE:** Comparative Risks of Multiple Chemical Exposures  
**PROJECT MANAGER:** Pamela Shubat, Ph.D.  
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**LEGAL CITATION:** ML 1997, Ch. 216, Sec. 15, Subd. 10(a).  
**APPROPRIATION:** \$150,000

Statement of Objectives: The objectives of this comparative risk analysis are to: (1) evaluate children's exposures to multiple chemicals, including pesticides, metals, volatile organic chemicals (VOCs) and polyaromatic hydrocarbons (PAHs); (2) evaluate the relative significance of exposure pathways (i.e., ingestion, inhalation); and (3) compare and rank children's health risks for multiple chemicals. Ultimately, the goal of this analysis is to provide decision-makers with the information necessary to set priorities and establish policies to reduce children's exposures to contaminants.

Overall Project Results: The Minnesota Department of Health (MDH) is currently analyzing the data from the Minnesota Children's Pesticide Exposure Study to complete the comparative risk analysis. The progress to date includes: (1) the collection and analysis of indoor air samples and pesticide survey data from 308 households with children; (2) the collection and analysis of samples of air, water, soil, house dust, food, beverages, urine and hair in subset (102) of these homes; (3) the development of the final weighted data sets for the samples of metals, VOCs and herbicides; and (4) the completion of the "June 1999 Interim Report: Comparative Risk of Multiple Chemical Exposures." The report describes the framework for conducting the analysis, including the exposure algorithms, toxicity values, and the data which will be used to evaluate children's health risks.

Project Results Use and Dissemination: The MDH has evaluated the exposure distributions and the summary statistics for the VOC and pesticide data. These and the other data from the study will be used to determine reference ranges for children's exposures to multiple chemicals. In addition, the data will be used to derive estimates of children's exposures to compare and rank health risks. A final report on the results of the comparative risk analysis will be provided to the LCMR by December 1999. This report will assist decision-makers to evaluate priorities for reducing children's exposures to contaminants.

The MDH also summarized the results of the household pesticide survey in the February 1999 report, "Minnesota Household Pesticide Survey." This report was distributed to state and local agencies, study participants, environmental organizations, interested citizens, researchers, and the LCMR. In addition, the MDH has provided the results of the VOC air monitoring and pesticide survey to study participants. Presentations have been conducted for several groups, including state and local agencies, schools, environmental organizations, scientific meetings, and the LCMR Citizen's Advisory Council. The dissemination of the results of the pesticide study will continue, as researchers analyze and interpret the data, and the comparative risk analysis is completed.

JUL 01 1999

**Date of Report:** July 1, 1999

**LCMR Final Work Program Update Report**

**I. PROJECT TITLE:** Comparative Risks of Multiple Chemical Exposures

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**Total Biennial Project Budget:**

\$ LCMR	\$150,000	\$ Match (federal)*	\$913,400
\$ LCMR (amount spent)	\$150,000	\$ Match (amount spent)	\$913,400
\$ LCMR Balance	\$0	\$ Match Balance*	\$0

\* Please note: a match was not required for this project. However, a substantial amount of federal grant dollars was used to carry out this proposal. In addition to the amount shown above, a \$750,000 federal grant was awarded to the University of Minnesota to carry out an expansion of the study; these dollars were not included in the match dollars.

**A. Legal Citation:** ML 97, Ch. 216, Sec. 15., Subd. 10 (a).

**Appropriation Language:** This appropriation was from the future resources fund to the commissioner of health to develop comparative risk information for managing exposures to multiple environmental hazards from measurements of pesticides, volatile organic compounds, and metals in soil, air, water, and food.

**B. Status of Match Requirement:**

Although there was no match requirement for receiving these funds, a substantial amount of federal funds were used to carry out this study. This proposal was based on a study designed and implemented by the U.S. Environmental Protection Agency (US EPA) and their contractors to study environmental hazards in US EPA Region V, a six-state region that includes Minnesota. The study, the National Human Exposure Assessment Survey (NHEXAS), included a small study of children's exposures to pesticides which was conducted only in Minnesota. The match that was indicated was the amount US EPA budgeted for the design and implementation of the pesticide study, plus additional funds from the U.S. Centers for Disease Control and Prevention (CDC) to carry out special portions of the study. The University of Minnesota (UM), through

Dr. Ken Sexton of the Center for Environmental Health Policy, also participated in this study and received \$750,000 in additional US EPA funding which doubled the size of the study. The LCMR expanded the study solely for sample collection and analysis.

## **II. PROJECT SUMMARY AND RESULTS:**

Comparative risk information for managing exposures to multiple environmental hazards will be derived from measurements of pesticides, volatile organic compounds, and metals in soil, air, dust, water, and food.

The LCMR produced Minnesota comparative risk data by expanding a federal study of environmental exposures. This federal study, NHEXAS, measured environmental and biological levels of metals and volatile organic compounds in a random sample of residences in US EPA Region V. NHEXAS produced exposure data representative of the region but not the state. NHEXAS included a special study of pesticide exposures to children in 50 Minnesota homes. The University of Minnesota increased the sample size to a total of 100 homes. Air, water, dust, soil, and food were sampled as well as the blood, urine, hair, and surface of the skin of participants. The LCMR expanded this pesticide study by including analyses for metals (e.g., lead, arsenic), volatile organic compounds (e.g., benzene, trichloroethylene), and herbicides (e.g., 2,4-D). An important component of the study was a screening step that provided limited air exposure data on a representative sample of 300 households with children in metropolitan and rural southeastern Minnesota.

Decision-makers will be able to use the results of the LCMR expanded study to compare Minnesota exposures, and health risks from exposures, to US EPA Region V exposures. The relative risks of the environmental hazards measured in each of the 100 households will be characterized along with the relative importance of the pathways of exposure. Finally, by focusing on children the results can be used to better understand the impact of these hazards on sensitive populations.

## **III. PROGRESS SUMMARY:**

**Participant Recruitment:** Participants were successfully recruited for the screening and intensive phases of the pesticide study. In the screening phase, 308 households (225 metro, 83 Goodhue/Rice Counties) provided information about pesticide use and household demographics. Based on the results, 102 children (72 metro, 30 Goodhue and Rice Counties) were selected for intensive sampling to measure for pesticides, polyaromatic hydrocarbons (PAHs), metals, and volatile organic chemicals (VOCs).

Participation rates for collecting the samples varied depending upon the type of sample, the parents, and the participant. The participation rates ranged from 60% to 100%. Rates were higher than expected across all samples -- especially given that all of the participants were children (3 to 12 years), and that the large number of samples placed a high level of burden on participants.



**Sample/Data Collection:** Samples for the pesticide study were collected from May to October 1997. Air monitors (3M, organic vapor monitor) were deployed in the 308 screening homes. These monitors measured 6-day average indoor air concentrations of 10 VOCs (e.g., benzene, toluene, chloroform). The MDH also administered questionnaires in each of the homes to collect information about demographics, pesticide use, smoking status, and household activities related to VOC exposure. In addition, the MDH completed an inventory of all of the pesticide products which were stored and/or used in and around the homes.

During the intensive phase of the study, US EPA contractors sampled 102 of the households for multiple chemicals in the air, water, soil, house dust, beverages, and food. Biological samples of blood, urine, and hair were also collected from a child in each home (for a list of the LCMR samples and estimated costs, refer to Table 3, page 10). These samples were collected and shipped to US EPA contractors for analysis.

**Sample Analysis:** Sample analyses for the study were conducted according to US EPA protocols for metals, VOCs, pesticides and PAHs. These analyses included testing over 2100 samples for multiple chemicals (for a complete list of all chemicals and samples in the study, refer to Tables 1 and 2 in the Appendix of the "June 1999 Interim Report: Comparative Risks of Multiple Chemical Exposures.")

US EPA contractors have completed analyses for all samples in the study, with the exception of the blood samples. The blood samples were archived by US EPA contractors, and will be analyzed for metals by the Centers for Disease Control at no cost to the MDH.

US EPA contractors have analyzed for 2 additional herbicides in the floor dust samples at no additional cost. These include MCPP (mecoprop) and MCPA (dimethylamine salt).

**Data Analysis:** US EPA contractors provided the weighted data for the metal and VOC samples in June 1999. The weighted data sets for the other samples (i.e., pesticides and PAHs) are nearly complete and are expected by July 1999. The MDH is currently in the process of analyzing the metal and VOC data to prepare for the comparative risk analysis.

In addition, the MDH has analyzed the data from 308 households with children regarding pesticide storage and use. The results have been summarized in the February 1999 MDH report, "Minnesota Household Pesticide Survey." Analyses of the survey data are ongoing, as the MDH has received specific requests for data from local and state agencies.

**Comparative Risk Analysis:** The MDH has established the framework for conducting the comparative risk analysis using the data from the pesticide study. Detailed information regarding the data and the methods for conducting the analysis are summarized in the attached report ("June 1999 Interim Report: Comparative Risk of Multiple Chemical Exposures"). The results of the analysis will be provided in a follow-up report to the LCMR by December 1999.



The MDH has identified the exposure algorithms and the assumptions which will be used to estimate children's exposures. In addition, the MDH has evaluated and selected toxicity values for each chemical in the study. These values will be used to quantify and ultimately to compare children's health risks from chemical exposures. The MDH also has formed the Comparative Risk Steering Committee, which is a committee of MDH technical staff that meets regularly to share expertise and to develop consistent MDH policy for the analyses.

**Data Dissemination:** Data dissemination for the pesticide study is an ongoing process that will continue as researchers conduct analyses. To date, the disseminated data include:

- Household Pesticide Survey Report: In February 1999 the MDH distributed a report which summarized the results of the pesticide survey data collected from approximately 300 households with children. This report was distributed to state agencies (e.g., Minnesota Department of Agriculture), local public health agencies, environmental organizations, researchers, study participants, interested citizens, and the LCMR.
- Fact sheet and summary of air monitoring results: In July 1998 the MDH disseminated the results of the VOC air monitoring to participants in the study. The MDH also provided summary statistics for all households, and a fact sheet with background information on VOC sources in the home and steps which may be taken to minimize VOC exposure.
- Scientific meetings and papers: Preliminary data have been presented at scientific meetings, including the International Society for Exposure Analysis (Boston 1998), and the Society for Risk Analysis (New Orleans, 1998). In addition, the following papers are being reviewed for publication in the *Journal of Exposure Analysis*: "Household Pesticide Storage and Use Patterns in Minnesota," and "Design Strategy for a Multipathway Pesticide Exposure Study in Children." Several other papers are expected as additional data analyses are conducted.
- Presentations: The MDH has conducted presentations on the study to local public health agencies, University of Minnesota, Minnesota Department of Agriculture, Hennepin County Solid Waste, Minnesota Pollution Control Agency, environmental organizations, schools, and the LCMR Citizen Advisory Council. In November 1998, the results of the closely related NHEXAS study in EPA Region V also were presented by US EPA contractors to state and local agencies. These data included measurements of metals and VOCs from the Region V Study, conducted in six Midwest states -- including Minnesota. In June 1999, the MDH also prepared a poster for the Minnesota Rural Health Conference, "Pesticides and Children: Urban and Rural Exposures."

The dissemination of data for this study will be an ongoing process, as data are analyzed and interpreted. The MDH anticipates continuing dissemination through presentations, fact sheets,

scientific meetings, and the Internet. A final report on the comparative risk analysis will be provided to the LCMR in December 1999.

#### **IV. OUTLINE OF PROJECT RESULTS:**

The LCMR provided a unique opportunity to enhance and expand an ongoing study of exposures Minnesota children have to pesticides. The NHEXAS study was a multi-million dollar, peer-reviewed study designed by the US EPA to characterize environmental exposures to selected metals and volatile organic compounds (VOCs). Minnesota was one of six states that participated in the study. A special NHEXAS pilot study, budgeted by the US EPA at approximately \$550,000, looked solely at pesticide exposures in a small number of Minnesota children. This project enhanced the pesticide study in Minnesota by producing data on additional environmental hazards so that the results may be compared to the regional NHEXAS study (Figure 1). This project generated information about exposures to lead, arsenic, benzene, trichloroethylene, chloroform, and tetrachloroethylene. In addition, an additional herbicide widely used in Minnesota (i.e., 2,4-D), was added to the pesticides selected by the US EPA for inclusion in the children's pesticide study. The LCMR expanded study provided data to compare the risk information on pesticide exposures with risk information on two other major classes of environmental contaminants, metals and VOCs. These comparisons were made only on a household basis as the study population was biased towards selecting participants that have a high probability of exposures to pesticides.

The LCMR also expanded the study by increasing the number of Minnesota homes that were sampled for a limited number of contaminants. The Minnesota Department of Health (MDH) was interested in generating data, albeit less extensive, that were representative of a population larger than the 100 households selected for intensive sampling. To meet this need, the US EPA and contractors at Research Triangle Institute (RTI) designed a screening protocol that randomly selected children in 300 households located in geographic areas of interest to the MDH and US EPA. Data collected from this screening survey were representative of households with children and allowed inferences to be drawn about certain exposures within limited geographic areas. The MDH conducted this screening survey using funds from a CDC block grant that was available for environmental assessment activities. The LCMR expanded this study to measure levels of VOCs in residential air. Pesticide use data were collected through questionnaires and household inventories of pesticide products. Results of the screening study were used to select the 100 homes for additional, intensive sampling (Figure 2).

A. Screening survey, sampling, and analysis for indoor air and questionnaire data: In the summer of 1997, MDH used CDC funding to staff a screening survey designed by MDH, UM, US EPA and RTI. Families of children in 300 randomly selected homes from Minneapolis, St. Paul, and rural Goodhue and Rice Counties were interviewed for pesticide use, and staff inventoried household pesticide products. LCMR expanded the study to sample indoor air for VOCs. State funds were used for salaries for MDH staff to coordinate the screening survey, assist in the survey, and supervise staff conducting the survey.



LCMR Budget	\$32,640	VOC sampling and analysis
Completion date for sampling		August 31, 1997
Completion date for VOC analysis		February 28, 1998

The questionnaire data collected in the screening survey were analyzed immediately and used to select 100 homes for additional sampling. This pilot study was intended to test survey methodology on homes with a range pesticide exposures, so the selection was biased towards individuals and homes that indicated pesticide exposure has occurred.

B. One hundred-household survey measuring levels of pesticides, metals, or VOCs in air, water, dust, soil, and food, and participant's blood, hair, urine, and surface of skin: During the summer of 1997, samples and questionnaire data were collected from children in 100 households selected from the screening survey. Samples were analyzed over the following two years. US EPA contractors conducted the analyses of samples for metals, VOCs, and pesticides. The LCMR expanded the study to pay for sample collection and analysis for metals, VOCs, and 2,4-D. US EPA funds payed for the analysis of all other pesticide samples.

LCMR Budget	\$100,860	sampling and analysis for metals and VOCs
Completion date for sampling		September 31, 1997
Completion date for analysis by RTI		May 31, 1998

C. Data management and data analysis: During the years following the sampling, analysis of the data will allow researchers to determine major pathways of exposures. Products will include an environmental data base and a quantitative description of the apportionment of exposures among exposure pathways for each environmental hazard. State funds were used to pay MDH staff to manage the data generated for the MDH.

LCMR Budget	\$16,500	data management and analysis
Completion date for data storage and transfer to MDH		May 31, 1999

D. Comparative risk: As data are stored and transferred throughout 1998 and 1999, human health risks from exposures to pesticides, metals, and VOCs will be compared using risk assessment methods and the data from this study. Products include a quantitative comparison of the exposures to children and adults, quantitation of exposure pathways for children, an analysis of the relationships between environmental levels and absorbed doses for children, and comparisons of the health risks from different environmental hazards. MDH staffing will be an in-kind contribution to the project.

LCMR Budget	\$0	
Completion date		June 30, 1999

## **V. DISSEMINATION:**

Dissemination of data from the US EPA Region V NHEXAS study began with communication to state health departments and participants about results of the sampling performed in their homes. Similar dissemination of analytical results to individuals enrolled in the pesticide study has been conducted. Results of this collaborative research have also been shared with research institutions working on the NHEXAS project, states in US EPA Region V, and Minnesota state agencies including the Pollution Control Agency and the Department of Agriculture. Details of the design of NHEXAS have already been published in national research journals (*Journal of Exposure Analysis and Environmental Epidemiology*, September 1995, special issue). Results of the LCMR enhanced study will also be prepared for publication and/or presentation through appropriate professional societies such as the International Society for Exposure Analysis and the Society for Risk Analysis. The MDH will present information about this research on its web site.

The MDH publishes an annual report of environmental data generated by the MDH. The report is disseminated to local government, through local public health agencies, in every Minnesota county. This report will contain a section on the NHEXAS survey in the year that summary data are available.

## **VI. CONTEXT:**

### **A. Significance:**

Despite numerous efforts at state and national levels to generate risk comparisons, states do not have all the tools or information necessary to systematically rank risks of greatest importance to the health of their citizens. Current comparative risk projects in Minnesota focus on ranking risks based on perceptions of risk and limited environmental data. The State lacks the environmental and health information that makes quantitative comparisons of risk possible. Information on children's exposures to environmental hazards are particularly lacking, as pointed out in a 1993 report by the National Research Council titled *Pesticides in the Diets of Infants and Children*. One response the US EPA made to this concern was to designate a portion of the NHEXAS funding for a pilot study of children's exposure to pesticides. This study will take place in Minnesota during the summer of 1997. Minnesota worked with the US EPA, research contractors (RTI), and faculty at the UM to design the pesticide study for Minnesota. The pesticide study used sampling techniques of the US EPA Region V NHEXAS project.

The LCMR expanded the US EPA pesticide study by analyzing for metals and VOCs in the environmental and biological samples that the US EPA analyzed for pesticides. The US EPA pesticide study provided the study design, sample selection, and measurements of pesticide exposures of 100 Minnesota children and their households. Funds from the National Center for Environmental Health, CDC, will provide metals analysis of human biological samples.

The pesticide pilot study sampled only 100 households, a sample size that is too small to provide a statistically accurate description of Minnesotan's exposures to pesticides. In contrast, the US EPA Region V NHEXAS study of up to 400 randomly selected homes provided a statistically



accurate description of exposures to metals and VOCs in the Great Lakes Basin. Because LCMR expanded the pesticide study to include the entire suite of environmental hazards studied in NHEXAS, researchers will be able to link the metals and VOC results from the Minnesota study to the regional data. The information from this study provided environmental and health-related data for comparative risk rankings and risk management decision-making.

B. Time: (portions of the overall study that utilized LCMR-recommended appropriations are indicated)

May 12, 1997 to August 4, 1997:	Telephone survey for participant selection
May 20, 1997 to August 18, 1997:	In-home screening survey
June 9, 1977 to September 11, 1997:	Recruitment for intensive survey
June 22, 1997 to October 1, 1997:	Intensive survey (BUDGET: sampling costs begin to accrue in July)
September 1997 to February 1998:	Analyze VOC monitors (BUDGET: analysis costs)
October 1997 to May 1998:	Analysis of air, dust, dietary, and biological samples (BUDGET: sample analysis costs, data management costs)
November 1997 to August 1998:	Compilation of data and data quality control (BUDGET: data quality assurance and management costs)
January 1998 to January 1999:	Analysis of questionnaire data and sample data
April 1998 to June 1999:	Risk characterization and comparison (by MDH)
June 1999:	Final report of sample and data analysis

All of the costs for sampling and analysis were incurred during the grant period. Final results of this project will be reported to the LCMR in December 1999.

#### C. Budget Context:

The proposed project will produce comparative risk information for managing exposures to a variety of environmental hazards. The LCMR project paid for the analysis of VOCs and metals in dust, soil, air, water, and food and in biological tissues for 100 homes in the NHEXAS pesticide survey. US EPA funded the study design, sample selection, portions of the sample collection, and data analysis. Block grant funds for preventive health, passed to the MDH from the CDC for use in environmental assessment activities, were used to staff the screening survey of 300 randomly selected homes, purchase sampling supplies for MDH surveyors, and provide carbon monoxide monitors, radon detectors, or cash incentives to the 300 homes screened for the intensive follow up. Additional funds from the National Center for Environmental Health, CDC, will provide chemical analysis for biological samples from children in the 100 households.

**Table 1: Funding Source**

Source	July 1995-June 1997 Prior expenditures on this project	July 1997-June 1999 Proposed expenditures on this project	July 1999-June 2001 Anticipated future expenditures on this project
LCMR <sup>1</sup>	\$ 0	\$ 150,000	\$ 0
Other State Funds	\$ 0	\$ 0	\$ 0
Non State Match			
U.S. EPA <sup>2</sup>	\$ 230,000 <sup>(a)</sup>	\$ 550,000 <sup>(b)</sup>	\$ 50,000 <sup>(c)</sup>
U.S. CDC <sup>3</sup>	\$ 33,400 <sup>(d)</sup>	\$ 50,000 <sup>(e)</sup>	\$ 0
U.S. EPA <sup>4</sup>	\$ 0	\$ 750,000	\$ 0
In Kind <sup>5</sup>	\$ 10,000	\$ 40,000	\$ 10,000
Total	\$ 273,400	\$1,390,000	\$ 60,000

<sup>1</sup> The US EPA pesticide study was expanded by LCMR to measure 2,4-D, metals, and VOCs in samples the US EPA analyzed for pesticides.

<sup>2</sup> The US EPA funded the <sup>(a)</sup>development and testing of assays for screening, screening study design, sample selection, <sup>(b)</sup> sampling in the 50 home study (administration of questionnaires, use of sampling equipment, labor, packaging and shipping of environmental and biological samples), analysis of pesticides and data, and <sup>(c)</sup>statistical analysis of results of the screening study.

<sup>3</sup> The Centers for Disease Control and Prevention (CDC) block grant funds for environmental assessment activities purchased <sup>(d)</sup>incentives for participants, computers and other supplies and equipment, and staffing for a screening survey. The National Center for Environmental Health, CDC, is preparing to conduct <sup>(e)</sup>chemical analysis for biological samples from children in each household.

<sup>4</sup> The US EPA provided an additional \$750,000 to Dr. Ken Sexton, University of Minnesota Center for Environmental Health Policy, to double the size of the study--expanding the intensive sampling from 50 to 100 homes.

<sup>5</sup> Salary (5-10%) for environmental toxicologist for project planning and grant writing. Salary (50%) for a research scientist for project coordination, data management, and data analysis.



**Table 2: Funding allocations within the project**

Expenditure Category	July 1997-June 1999 Total LCMR requested amounts distributed to:
Personnel/equipment/acquisition/development	\$ 0
Other (see Table 3):	
Sampling Costs	\$ 34,060
Analysis Costs	\$ 99,440
Data Management and Analysis costs	\$ 16,500
Total	\$ 150,000

**Table 3: Sample collection and analysis costs for the project**

Sample type	Sample description	Sampling Costs	Analytical Costs	Total dollars
Air VOCs	300 indoor air samples for screening survey on 300 homes	10,880	24,000	32,640
Air VOCs	300 samples (personal, indoor, and outdoor) on 100 homes	4,080	24,000	29,710
Dust Sample lead arsenic 2,4-D	300 analyses on 100 homes	12,400	28,390	41,400
Dietary mercury arsenic	200 analyses on 4 day composite samples from 100 homes	5,200	15,000	20,200
Biological (hair) mercury arsenic	180 analyses on samples from 90 persons	1,500	7,000	8,500
Water (wells) arsenic	30 analyses from 30 rural homes	0	1,050	1,050
<b>Total (dollars)</b>		<b>34,060</b>	<b>99,440</b>	<b>133,500</b>

Budget items were based on sampling and analysis estimates from the US EPA's NHEXAS project and from the MDH Public Health Laboratories. The NHEXAS principal investigator, Dr. Edo Pellizzari, Research Triangle Institute, North Carolina, supplied the estimates. Sampling and analysis were carried out by this investigator.

State and federal funds provided in kind and matching funds, respectively. Approximately ten and fifty percent of the salaries of an MDH environmental toxicologist and an environmental research scientist, respectively, were assigned to this project. In addition, up to ten percent of the time of a University of Minnesota environmental policy scientist were devoted to this project.

Federal funds from the US EPA paid for the study design, sample selection, sampling (use of sampling equipment, labor, packaging and shipping of environmental and human biological samples), analysis of pesticides, and statistical analysis of the results. Federal funds from the CDC paid for the analysis of biological samples from children in each household. Federal funds from the CDC preventive health block grant were used primarily for staffing for the screening survey.

#### **VII. COOPERATION:**

Sampling was performed by US EPA contractors. Laboratory analysis was contracted to US EPA vendors. Data analysis was a collaborative effort by the US EPA and its contractors, the University of Minnesota, and the MDH, with consultation from the Minnesota Department of Agriculture. In addition, the Public Health Service of Goodhue-Wabasha Counties collaborated in the study by assigning two field staff to conduct home interviews and deploy air monitors.

Collaborators include: Ken Sexton, Sc.D., M.B.A., Director, Center for Environment and Health Policy, University of Minnesota; James Quackenboss, Environmental Scientist, Principal Collaborator for the RTI/EOHSI Cooperative Agreement, U.S. Environmental Protection Agency; Edo Pellizzari, Ph.D., Vice President, Analytical and Chemical Sciences, Research Triangle Institute; Larry Needham, Ph.D., Chief, Toxicology Branch, National Center for Environmental Health, Centers for Disease Control and Prevention; and Greg Busicky, Director, Agronomy Services Division, Minnesota Department of Agriculture.

#### **VIII. LOCATION:**

Ecological classification locations, and B,R,S, and W contained sampling sites for the US EPA Region V NHEXAS survey that served as a comparison group to the findings generated with this LCMR project. The US EPA pesticide survey took place in Minneapolis, St. Paul, and the rural areas of Goodhue and Rice Counties (R,V,W, X, and S).



## **IX. REPORTING REQUIREMENTS:**

Periodic work program progress reports were submitted starting in December, 1997. Topics that were covered were:

December 1997:	Status of screening sampling on 300 homes and status of air monitoring in those homes
September 1998:	VOC levels on the randomly selected population
February 1999:	Results of chemical analysis on 100 homes
June 1999:	Final report on sampling and analysis

The MDH will report the results of the comparative risk analysis to LCMR in December 1999.

## **X. RESEARCH PROJECTS:**

NHEXAS has undergone extensive review by scientists during its development at the US EPA and RTI. Reviews began with the evaluation of existing federal databases in order to document the need for exposure measurements (Sexton et. al., 1992, *Archives of Environmental Health* 47(6):398-407). In 1992, design workshops hosted by US EPA involved federal scientists in US EPA's program and regional offices, and non-federal scientists. These workshops examined NHEXAS study designs and pollutant lists. In 1993, a Request for Proposals for competitive Cooperative Agreements to conduct NHEXAS pilot studies on a state-wide or regional basis was issued. The proposals that were received were reviewed by a panel made up of US EPA scientists and a panel of scientists from other federal agencies including the Agency for Toxic Substances and Disease Registry, the Centers for Disease Control and Prevention, the Food and Drug Administration, the National Cancer Institute, the National Institute for Occupational Safety and Health, and the National Institute for Environmental Health Sciences. Based on these reviews, three studies were selected for funding, including the RTI population-based survey in US EPA Region V.

Specific project quality assurance plans (Quality Systems Implementation Plans or QSIPs) were developed by RTI. These were reviewed by an independent panel of US EPA scientists to determine if the proposed designs and methods were adequate to meet the study objectives. Pre-testing was used to revise and refine the study collection methods. The plans were reviewed again by the panel and also by the US EPA Principle Collaborator who ensured that reviewer comments had been adequately addressed. The study design and protocols for the pesticides study, which were developed with US EPA, RTI, and the MDH, was submitted for review as an appendix to the RTI QSIP prior to conducting the field study.

A series of papers describing the overall NHEXAS program and details of the specific studies were published in the peer-reviewed *Journal of Exposure Analysis and Environmental Epidemiology* (Volume 5, Number 3, July-September, 1995).

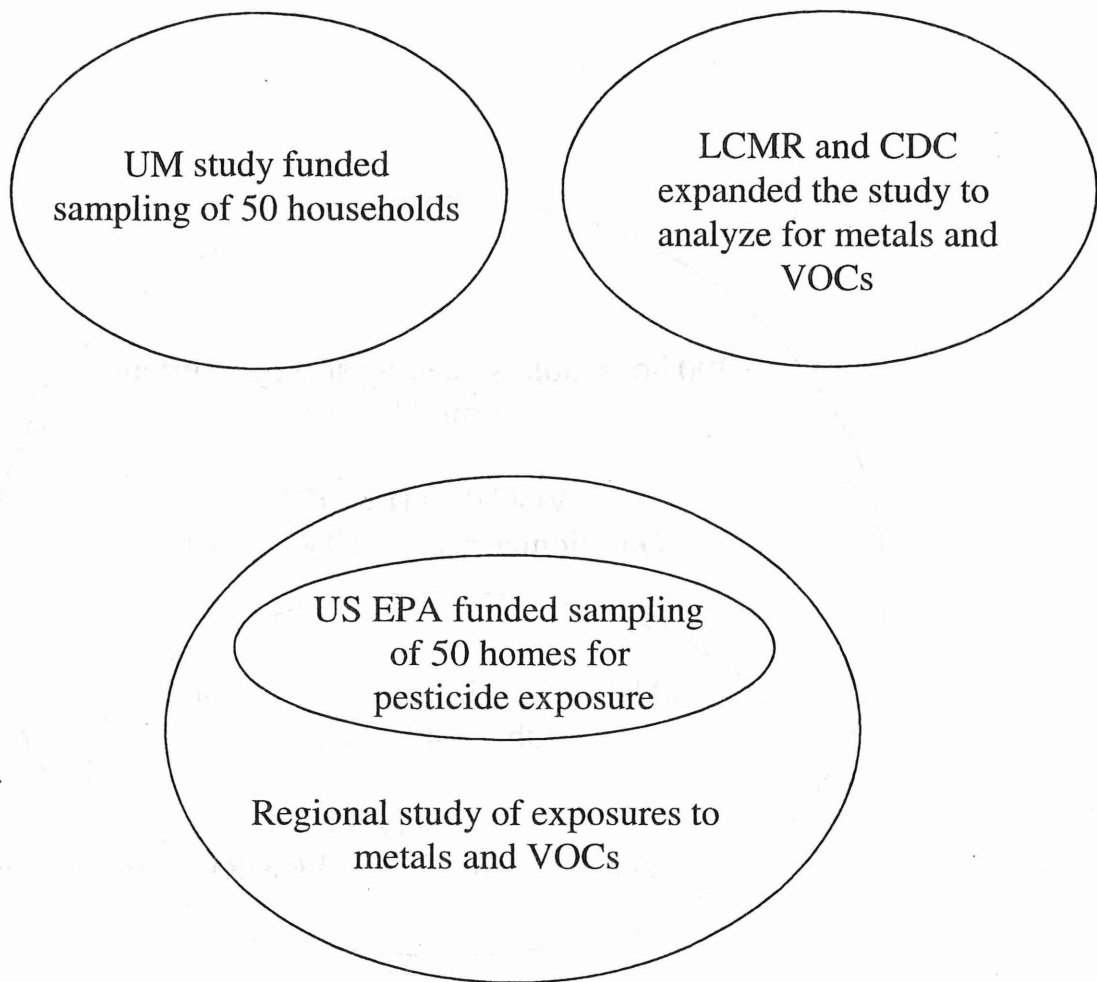


Figure 1: Funding sources: The NHEXAS study took place from 1996 to 1997 in US EPA Region V, a six-state region that includes Minnesota. The study was a random survey of the exposures of residents of all ages to metals and VOCs. A separate portion of the NHEXAS study design included a small study of children's exposures to pesticides. LCMR and CDC expanded the study to provide the data that will allow for comparisons to be made between the two studies. A UM study doubled the size of the US EPA part of the study.

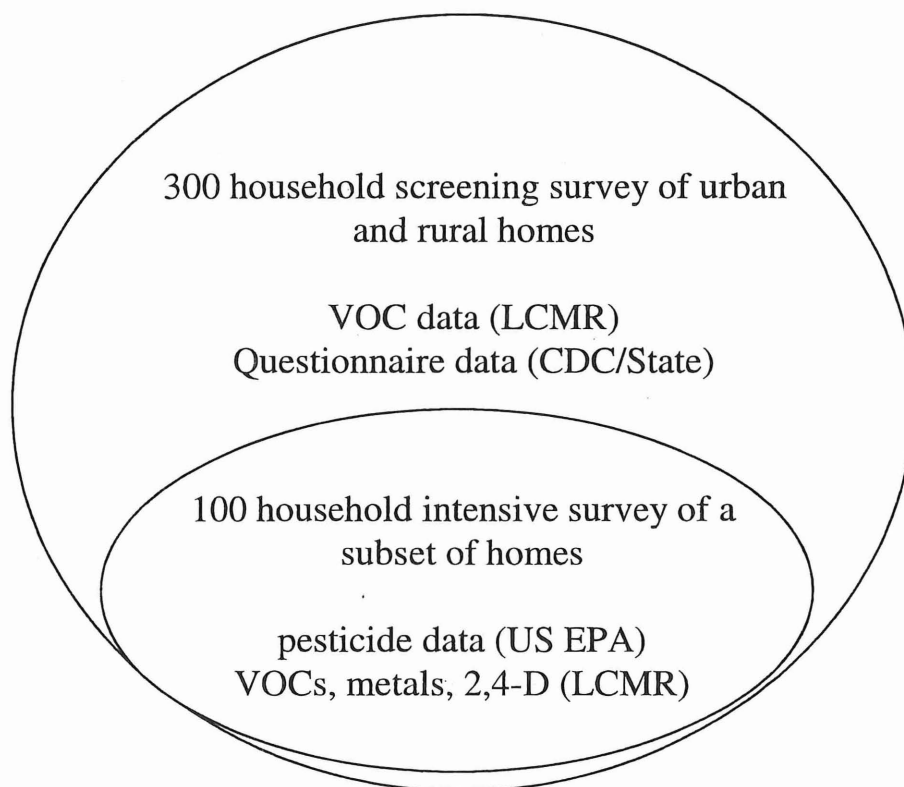


Figure 2: Study population: The 100 households shown above were selected from a screening survey of 300 randomly selected homes with children and a known probability of using pesticides. EPA measured pesticide exposures in homes enrolled in the intensive survey. LCMR and CDC expanded the study to analyze for metals and/or VOCs in both the screening and intensive surveys in order to relate the results to a six-state, random survey (NHEXAS) of exposures to metals and VOCs.



## Supplementary: Detailed Budget

All costs for the LCMR enhanced part of this project were for sampling and analysis of media for VOCs, metals, and 2,4-D. The contractor did not provide a detailed breakdown of each cost. However, these costs included labor and materials. For example, the VOC air sampler was a passive monitor that costed about \$20.00 to purchase. Labor and materials for the extraction and analysis of the contents was approximately \$80.00. In addition, there were labor costs for staff to deploy the monitors, prepare them for shipping and for analysis, and record data. Shipping was another cost included in the sampling costs shown below.

Sample type	Sample location	Number of samples	Sampling Costs	Analytical Costs	Total (dollars)
Air Screening samples for VOCs	1, indoor	300 samples	10,880	24,000	32,640
Air Intensive samples for VOCs	1, personal (optional) 1, indoor 1, outdoor	100 samples 100 samples 100 samples	4,080	24,000	29,710
Dust Wipe Dust lead Dust arsenic Dust 2,4-D	1, living area same sample 1, entranceway	100 samples 100 samples 100 samples	12,400	28,390	41,400
Dietary Food-mercury Food-arsenic	4 day composite same sample	100 samples 100 samples	5,200	15,000	20,200
Biological Hair-mercury Hair-arsenic	1 sample (optional) same sample	90 samples 90 samples	1,500	7,000	8,500
Water (wells only) Arsenic	1 sample (collected for other analysis)	30 samples	0	1,050	1,050
Total (dollars)			34,060	99,440	133,500

Overall cost categories and budget for the LCMR grant:

Category	Cost (in dollars)
Collection	\$34,060
Analysis	\$ 99,440
Data analysis and management; including quality assurance/quality control	\$ 16,500
total	\$ 150,000

Supplementary detailed time line: (portions of the overall study that will utilize appropriations recommended by LCMR are indicated)

May 12, 1997 to August 4, 1997:	Telephone survey for participant selection
May 20, 1997 to August 18, 1997:	In-home screening survey
June 9, 1977 to September 11, 1997:	Recruitment for intensive survey
June 22, 1997 to October 1, 1997:	Intensive survey (LCMR BUDGET: sampling costs begin to accrue in July)
September 1997 to February 1998:	Analyze VOC monitors (LCMR BUDGET: analysis costs)
October 1997 to May 1998:	Analysis of air, dust, dietary, and biological samples (LCMR BUDGET: sample analysis costs, data management costs)
November 1997 to August 1998:	Compilation of data and data quality control (LCMR BUDGET: data quality assurance and management costs)
January 1998 to January 1999:	Analysis of questionnaire data and sample data
April 1998 to June 1999:	Risk characterization and comparison (by MDH)
June 1999:	Final report of sample and data analysis