

Environmental Public Health Tracking & Biomonitoring

Report to the Minnesota Legislature

Minnesota Department of Health

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Environmental Public Health Tracking & Biomonitoring

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EXECUTIVE SUMMARY

In 2007, the Minnesota Legislature passed a law creating the Environmental Health Tracking and Biomonitoring program at the Minnesota Department of Health (MDH). This legislation, Minnesota Statutes, sections 144.995 to 144.998, was signed into law and took effect on July 1, 2007. It directs MDH, in cooperation with the Minnesota Pollution Control Agency, to do the following:

Establish an environmental health tracking program to collect, integrate, analyze and disseminate data to track how much people in Minnesota are exposed to hazards in the environment and to identify the diseases that are caused or aggravated by those chemicals.

- Coordinate data collection with the Pollution Control Agency, Department of Agriculture, University of Minnesota, and any other relevant agencies to promote the sharing of and access to health and environmental databases..., consistent with applicable data practices laws.
- Implement a pilot biomonitoring program, including four pilot projects to measure communities' exposure to arsenic, perfluorochemicals (PFCs), mercury, and a fourth chemical to be selected by MDH.
- Develop biomonitoring program guidelines that address the science and practice of biomonitoring and make recommendations for conducting ongoing biomonitoring.
- Create an Environmental Health Tracking and Biomonitoring (EHTB) Advisory Panel to recommend program priorities
- Provide a biennial status report to the Legislature, according to Minnesota Statutes, section 144.996, subdivision 1, paragraph (6) and subdivision 2, paragraph (5).

This report summarizes the activities of the environmental health tracking program, the pilot

biomonitoring program, and the Environmental Health Tracking and Biomonitoring Advisory Panel. It fulfills the requirements of the statute that MDH submit a biennial report to the chairs and ranking members of the legislative committees with jurisdiction over environment and health on “the status of environmental health tracking activities and related research programs, with recommendations for a comprehensive environmental public health tracking program” and on “the status of the biomonitoring program and any recommendations for improvement.”

MDH released technical reports in 2009 and 2010 that described results for two of the pilot biomonitoring projects. These results are summarized in the appendices, and complete reports are available on the program website (<http://www.health.state.mn.us/tracking>). In addition, four data reports for the environmental health tracking program were released in 2009 and 2010 for environmental hazards and health conditions. These included data tracking carbon monoxide poisonings, chronic respiratory disease and heart attack hospitalizations, childhood blood lead levels, and drinking water quality.

Environmental Public Health Tracking Program

The Minnesota Environmental Public Health Tracking (MN EPHT) program makes available a wide range of data collected by government programs on environmental hazards, chemical exposures and health in one place for ease of access and use by the public. By monitoring these data and improving access, the MN EPHT program has created new opportunities for understanding data trends and geographic differences, and recognizing disparities across the state. The data can then be used to inform public health decisions and encourage individual actions aimed at preventing diseases and reducing exposures to environmental hazards.

State support of the MN EPHT program was highly successful in leveraging additional federal support. In 2009, Minnesota was awarded a cooperative agreement grant by the CDC and

joined the National Environmental Public Health Tracking Network of 23 states and New York City.

The MN EPHT strategic plan, originally developed in 2008, has helped to guide the program toward fulfilling its mission of building knowledge about health and the environment and driving actions to protect the health of Minnesota communities. The goals outlined in the plan focus on data quality; data accessibility and usefulness; communication and data dissemination; stakeholder engagement; and building collaborations with data users.

To date, the MN EPHT program has gathered data and measures in 8 core content areas for tracking.

These include:

- ambient air quality
- drinking water quality
- childhood blood lead
- respiratory and heart disease hospitalizations
- cancers
- birth defects
- reproductive outcomes
- carbon monoxide poisonings

Minnesota's EPHT program is working with other states and the CDC in developing new data for tracking pesticide hazards and health impacts of climate change in the state. We are also exploring state-specific data, in consultation with the EHTB Advisory Panel, for tracking population exposure to radon and environmental tobacco smoke. Tracking will allow us to observe population level changes in these exposures due to state, local and individual actions.

To improve public access to environmental public health data, staff are currently working on the implementation of a state web-based information system (portal). Summary data from Minnesota are also submitted to the CDC and included on a national EPHT web portal, an important part of our participation in the CDC-funded national environmental public health

tracking network. Public health messages that accompany the data, along with education and outreach are important parts of this new system for disseminating information. Local public health agencies are a primary audience for this information system, which will aid in county and community level health assessments.

Program staff have begun work in collaboration with academic institutions to identify core priorities for research – including specific, targeted studies – to study the associations between environmental health hazards, exposures and disease. Staff have provided data to a CDC-funded study of air quality and reproductive outcomes by the University of Medicine and Dentistry New Jersey.

MN EPHT has begun to stimulate improvements in the way state and local public health programs access and use environmental and public health data. For example, the implementation of the carbon monoxide (CO) alarm law and the establishment of measures for CO poisonings illustrate that tracking programs can be used to evaluate the impact of actions to prevent CO poisonings.

Biomonitoring Pilot Program

In accordance with Minnesota Statute 144.997, Subdivision 1, paragraphs (1) to (3). MDH has developed a pilot biomonitoring program and has implemented four pilot projects to measure the amounts of selected chemicals present in people. The program is responsive to community concerns about exposure to chemicals that are found in food, soil, drinking water and consumer products. The four components of the pilot project are...

Minneapolis Children's Arsenic Study:

Measured urinary arsenic among 65 children in a community with soil contamination. Project results were released in April 2009 (see Appendix A.)

East Metro Perfluorochemicals (PFCs)

Study: One hundred ninety-six adults selected from two communities exposed to contaminated drinking water participated in the study, which measured PFCs in blood

serum. Project results were released during spring 2009 with additional data analyses in 2010 (see Appendix B). In late 2010, a follow-up study recommended by the EHTB Advisory Panel was initiated to examine changes in the levels of PFCs in serum that are likely to have occurred over the two years since first specimens were collected.

Riverside Prenatal Biomonitoring Study:

This study measured cotinine from secondhand smoke exposure and environmental phenols (including bisphenol A or BPA) from consumer product use in pregnant women and was conducted in partnership with investigators from the University of Minnesota. Participant recruitment and specimen collection was completed in spring 2010. Laboratory analysis for environmental phenols is underway and overall project results are expected to be released in 2011.

Lake Superior Mercury in Newborns Study:

This study measured mercury exposure among newborns living near Lake Superior who are potentially exposed through maternal fish consumption. Mothers of newborns gave their informed consent for MDH to test their baby's newborn screening blood spot for mercury levels. The project is part of a larger (3-state) study funded by the U.S. EPA and uses a novel laboratory method developed by the MDH Public Health laboratory.

MDH has already learned valuable lessons about implementing a biomonitoring program as a result of this pilot program, and has developed procedures and approaches that will be beneficial should future biomonitoring efforts be undertaken. Partly because of these advances, in 2010, MDH successfully obtained a federal grant from the CDC through the Great Lakes Restoration Initiatives for biomonitoring of contaminants found in areas of concern for the Great Lakes.

Biomonitoring program guidelines

Minnesota Statute 144.997, subdivision 4, paragraph (b), clauses (1) and (2), directs MDH

to develop program guidelines to address the science and practice of biomonitoring. Program staff, in consultation with the EHTB Advisory Panel, developed guidelines to inform decisions about the design and implementation of the four biomonitoring pilot projects. These guidelines define the primary purpose of the state's pilot biomonitoring program as providing information about the distributions and ranges of exposure to specific chemicals in the selected communities. The guidelines set standards for program development and implementation in the following areas: pilot project design, privacy of information, informed consent, laboratory quality assurance, laboratory approval program, storage of specimens, use of stored specimens for future research, communication of results, community acceptance and participation, follow-up counseling, selecting appropriate reference values for data interpretation, and inclusion of children in biomonitoring pilot projects.

In addition to guiding decisions about the four biomonitoring pilot projects, these guidelines, with ongoing review, provide a helpful framework for any future biomonitoring efforts carried out at MDH. Minnesota's guidelines have been shared with other state and national organizations looking to develop similar programs.

Lessons Learned and Recommendations for Ongoing Biomonitoring

Minnesota Statute 144.977, subdivision 2, paragraph (b), clause (4), directs MDH to develop and implement a base biomonitoring program based on the findings and recommendations gleaned from the biomonitoring pilot program. Staff and management from MDH, in consultation with the Advisory Panel, have engaged in a strategic planning process to develop such recommendations. To date, MDH has adopted a statement of vision and program goals, as well as a framework for guiding the development of targeted strategies to achieve the recommended goals.

The benefits and limitations of various approaches that the state could potentially use in implementing a biomonitoring program in the future are summarized in this document. MDH

recommends that ongoing biomonitoring in public health use a two-tiered approach, to include: a proactive consistent tracking approach for monitoring exposure over time in targeted segments of Minnesota's population, and a responsive approach for conducting special investigations of communities' concerns. This two-tiered approach offers the benefits of both strategies by maintaining and strengthening state capacity for biomonitoring over time, integrating exposure data with other public health tracking data, being prepared to respond to emerging events, and targeting resources where they are most needed for protecting public health.

Looking ahead, planning efforts will focus on prioritizing and recommending specific target populations and target chemicals that could potentially be included in future biomonitoring. Planning efforts will also address available resources for maintaining the state's biomonitoring capacity and infrastructure.

Environmental Health Tracking and Biomonitoring Advisory Panel

The Environmental Health Tracking and Biomonitoring Advisory Panel, established in 2007, meets four times each year and advises program staff and management on the planning and implementation of the biomonitoring and environmental health tracking programs. The panel comprises 13 individuals with strong backgrounds in scientific areas related to environment and health, and who represent a broad range of interests (business, local government, state government, non-profit organizations, etc).

Since the inception of the program, the Advisory Panel has made recommendations on a wide variety of issues, including biomonitoring pilot project designs; community selection; the development of program guidelines; interpreting the results of the biomonitoring pilot projects; recommending a biomonitoring chemical selection process; criteria for selecting new data and measures for tracking; and strategic directions for the development of the Minnesota Environmental Public Health Tracking Program.

Inter-Agency Steering Committee

The Inter-Agency Steering Committee, which meets regularly, engages key managers from relevant sections of the MDH, Minnesota Pollution Control Agency (MPCA), and Minnesota Department of Agriculture (MDA) to review program activities and the recommendations from the Advisory Panel. The committee chair represents the Commissioner of Health's office. The Steering Committee makes decisions on key issues to guide state tracking and biomonitoring activities in light of public health and agency priorities.

THE MINNESOTA ENVIRONMENTAL PUBLIC HEALTH TRACKING (MN EPHT) PROGRAM: PROGRESS REPORT

MN EPHT establishes a program mission and 4 strategic goals

In 2008, MDH, in collaboration with the Advisory Panel, adopted the following mission statement:

“The Minnesota Environmental Health Tracking System provides ongoing monitoring and analysis of information on hazards in the environment and the adverse health effects potentially related to those hazards. The program will integrate information on the environment and health and make it accessible to the general public, professionals and researchers in order to build knowledge about health and the environment and to drive actions to improve and protect the health of Minnesota communities.”

This mission directly aligns with MDH’s primary goal to protect, maintain and improve the health of all Minnesotans. Moreover, it integrates data and expertise from other state sources—the MPCA, MDA, and the University of Minnesota—into public health practice.

Today, MN EPHT is also guided by four primary program goals. These goals provide a strategic framework for the planning and activities of the program. Progress towards meeting each of the four program goals is described below.



GOAL 1: DEVELOP A STRONG ENVIRONMENTAL PUBLIC HEALTH TRACKING SYSTEM BASED ON THE COLLECTION AND ANALYSIS OF HIGH-QUALITY DATA.



The Minnesota Environmental Public Health Tracking (MN EPHT) program represents a systematic approach for gathering and integrating environmental hazard, human exposure and health data for the purpose of

informing actions, programs and policies that protect public health from environmental risks. This approach is similar to public health surveillance systems that have been used for years in tracking infectious diseases and risk factors, and has significantly advanced environmental epidemiology capacity within MDH for monitoring the public health consequences of environmental risks.



MN EPHT collects 3 types of data

Data that are part of MN EPHT are classified into three types: hazard, exposure and health.

Environmental hazard data are gathered to measure the extent to which environmental conditions or contaminants are present that pose a potential health risk to people in Minnesota. The term “environment” refers to our air, water, soil, homes, workplaces, communities and consumer products. Environmental hazard data currently being tracked by MN EPHT:

- *Drinking water quality:* MN EPHT reports on monitoring data that are routinely collected by public water suppliers and reported to the state drinking water information system.
- *Air quality data:* MN EPHT reports on particulate matter and ozone levels in ambient air from data collected by the Minnesota Pollution Control Agency.

Exposure data measure the presence of environmental contaminants in the body. Exposure data tracked by MN EPHT:

- *Childhood blood lead:* the level of lead measured in children’s blood by clinicians around the state, is reported to the Minnesota Blood Lead Information System.

Health outcomes data measure the occurrence of diseases or adverse health conditions that may be caused or aggravated (to some degree) by exposure to environmental conditions. Health outcomes that are tracked by MN EPHT include the following:

- Respiratory disease and heart attack hospitalizations: health events (such as asthma attacks) that are triggered by air pollutants.
- Reproductive outcomes: specific birth outcomes that can be related to environmental factors such as low birth weight and small for gestational age.

- Birth defects data collected by the Minnesota Birth Defects Information System track the occurrence of selected defects.
- Cancer data collected by the Minnesota Cancer Surveillance System (MCSS) track the incidence of cancers in the state.
- Carbon monoxide poisonings are tracked by monitoring emergency department visits, hospitalizations, death records, and poison center calls.

More information about the data that are currently part of MN EPHT can be found in Figure 1 below.

Figure 1: Minnesota Environmental Public Health Tracking data and measures

Air quality

EPHT air quality measures currently include short-term exposure to ozone and short- and long-term exposure to particulate matter less than 2.5 microns in aerodynamic diameter, also called fine particulate matter or PM_{2.5}. High levels of ozone and PM_{2.5} are the main known cause of poor air quality in much of the country. Both have been linked with respiratory and cardiovascular health effects. Air quality data are limited to areas of the state where air quality monitors are placed; currently this excludes most Minnesota counties. However, new methods developed by the national tracking network are being used in Minnesota to estimate particulate matter exposures in all counties.

Water quality*

The drinking water contaminants that are currently part of the EPHT program include regulated disinfection byproducts, arsenic and nitrates. High levels of nitrates in drinking water are associated with methemoglobinemia in infants, a life-threatening condition, and some evidence suggests that nitrates may increase risk of some cancers. Arsenic in drinking water is a known risk factor for certain cancers, as well as skin, neurological and circulatory effects. The initial focus for these contaminants is community water systems (CWS), which provide water to people year round in their places of residence. In 2010, Minnesota has approximately 960 community water systems that serve approximately 80% of Minnesota residents. EPHT tracks the number and percent of the population exposed to these contaminants through community water systems.

Childhood lead exposure*

Elevated blood lead levels (BLL) in young children have been associated with adverse health effects ranging from learning impairment and behavioral problems to death. The most common source of lead exposure for children today is lead paint in older housing and the contaminated dust and soil it generates. MN EPHT tracks the percent of children born in a specific year and tested for lead before the age of 36 months, the number and percent of pre-1950 housing units, and the number and percent of children under 5 living in poverty. These measures can be used to identify populations that are not being adequately tested, help parents determine if their child is at risk, and allow health care providers to identify children who should be tested for lead.

Hospitalizations (respiratory disease and heart attacks)*

Asthma hospitalizations have been associated with exposure to both particulate matter and ozone. Some research has also shown increases in heart attack hospitalization rates in relation to fine particles (PM_{2.5}), particularly in sensitive subpopulations such as the elderly and patients with pre-existing heart disease. Tracking measures for hospitalizations include the number and rate of hospitalizations for asthma and acute myocardial infarction (heart attack). In addition to these measures, MN EPHT has added hospitalizations for adult chronic lower respiratory diseases (which include diagnoses of chronic bronchitis, emphysema, bronchiectasis and chronic obstructive pulmonary disease or COPD) in persons age 55 and over who are susceptible to air quality hazards.

Cancer

Cancer is a diverse group of diseases characterized by the uncontrolled growth and spread of abnormal cells. Risk factors for cancer include personal behaviors (including cigarette smoking, alcohol consumption, diet, exercise, and exposure to certain medical drugs and hormones) environmental exposures (such as radiation, viruses, bacteria, and chemicals that may be present in the air, water, food, and workplace) and genetics. However, the causes of many cancer types are not well established, and the physical environment (air quality, chemical pollution, and water quality) remains a source of great public concern. MN EPHT will report cancer incidence from data collected by Minnesota Cancer Surveillance System.

Carbon Monoxide Poisoning*

Carbon monoxide (CO) poisoning resulting in illness or death is a significant, but often overlooked, public health problem in the United States. Unintentional exposure to CO can occur in households (e.g., faulty furnaces and water heaters), in occupational settings (e.g., motor vehicle or small engine exhaust gas), or in recreational settings (e.g., boat exhaust). Natural disasters resulting in large-scale power outages have also been associated with CO poisoning. Many of these poisoning events are completely preventable through the proper use of devices that burn fossil fuels, coupled with use of household CO detectors (now required by law in Minnesota). MN EPHT tracks the annual numbers and rates of CO poisoning-related hospitalizations, emergency department visits, deaths, and calls to the Minnesota Poison Control Center. MN EPHT has reported data for monthly and seasonal variations in CO poisoning rates and compared poisoning events according to residence status inside and outside of the Twin Cities metropolitan area.

Birth defects

Birth defects are a leading cause of infant mortality and are responsible for considerable morbidity and disability with enormous economic and social costs. Approximately 60% of birth defects are of unknown cause. The ambient environment remains a source of great public concern, but few environmental exposures have been well-studied. Most birth defects will likely ultimately be explained by a complex interaction between genetic predispositions and environmental factors. The specific birth defects selected for Tracking include anencephaly, spina bifida, hypoplastic left heart syndrome, tetralogy of Fallot, transposition of great arteries, cleft lip, cleft palate, gastroschisis, upper limb deficiencies, lower limb deficiencies, hypospadias and trisomy 21 (Down Syndrome). In Minnesota, information on the prevalence of birth defects is available only for Hennepin and Ramsey Counties since 2006 but, under new state legislation in 2009, the program is expanding to monitor birth defects statewide.

Reproductive outcomes

There are critical windows of development during pregnancy when environmental exposures could damage growth and function of a fetus. Reductions in birth weight or increases in low birth weight have been associated with exposures during pregnancy. Preterm birth rates may also be associated with exposures during pregnancy. Preterm birth and decreases in birth weight can lead to infant death, disease, disability, and developmental problems. EPHT tracks measures the percent of preterm and low birth weight births, mortality rates, fertility rates, and sex ratio at birth.

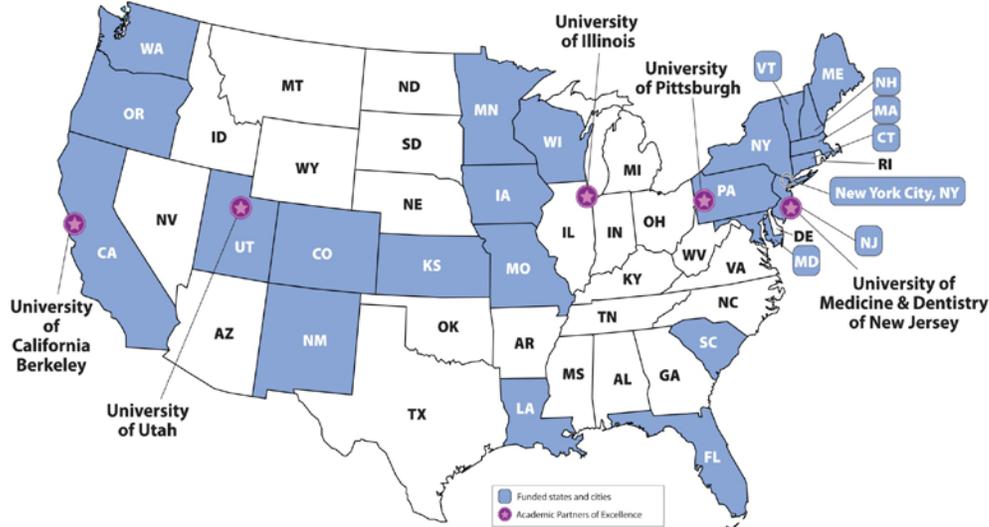
* State data reports available on the MN EPHT website: www.health.state.mn.us/tracking

MN EPHT joins the National Environmental Public Health Tracking Network

In 2009, Minnesota became one of six additional states to join the National Environmental Public Health Tracking (EPHT) Network at the Centers for Disease Control and Prevention (CDC). The national EPHT program began in 2002 and currently includes 23 states and New York City (See Figure 2 for a map of 2011 EPHT grantees). In 2009, the network launched a web-based, electronic information portal for the collection, integration and dissemination of nationally consistent health and environmental data.

Data and measures tracked nationally are standardized but can be limited by the available data across multiple states, a problem that is likely to increase with proposed reductions for federal funding to support the collection of environmental and public health data in government programs. Within the national network, Minnesota is unique for working with our state Legislature, Advisory Panel and stakeholders to develop a program that meets both state and national program goals and priorities.

Figure 2: National EPHT Grantees (2011)



MN EPHT builds a network of data partners

Working in partnership with data stewards (i.e., the people and programs that collect and maintain the data that are used in the tracking system), staff conducted inventories of available data located in state programs to determine which data sets are most useful. Data sets are selected on the basis of meeting federal as well as state program priorities.

MN EPHT Uses Data Protection Procedures

For data sets determined to be useful and high priority for tracking, MN EPHT staff completed written data use agreements with data stewards and obtained their approval through the MDH legal unit. The agreements document important information such as the legal authority by which the data are collected, shared and used; the data privacy classification and protections under the Minnesota Government Data Practices Act; the data elements that are collected; and the intended means for dissemination of the data.

To date, MN EPHT has established or is in the process of establishing data use agreements with the following data stewards:

- MDH Drinking Water Protection Program
- Minnesota Blood Lead Information System
- Minnesota Birth Defects Information System
- Minnesota Center for Health Statistics (vital records)
- Minnesota Injury and Violence Prevention
- MDH Health Economics Program
- Minnesota Cancer Surveillance System (MCSS)

MN EPHT works to develop new measures

In collaboration with other states, MN EPHT is exploring new ways of tracking population exposure to pesticides and the health impacts of climate change. Available pesticide data being explored include poison center calls, pesticide sales data, and groundwater monitoring data. Health impacts of climate change for tracking will likely include measures of heat-related hospitalizations and deaths that are related to extreme heat events. The elderly and low-income communities are most vulnerable to the effects of extreme heat.

With input from the Advisory Panel, staff are also working actively to prioritize and develop these new Minnesota-specific measures for tracking:

- radon levels in Minnesota homes
- children's exposure to secondhand smoke
- contaminant levels in household wells

An interagency team of technical staff have worked with the Advisory Panel to establish and pilot a process and determine the criteria for selecting new content for tracking. The process ensures that careful consideration is given to the scientific feasibility and public health importance of the measures to be tracked so that resources are used wisely.

MN EPHT protects individual data privacy

All data collected and maintained by MN EPHT are protected by the Minnesota Government Data Practices Act. MN EPHT data are classified as either public or private data. Environmental data (monitoring of air, drinking water, soil concentrations, etc.) are generally considered to be public data. Datasets that hold individual (identifiable) health information are private, accessible only to the subject of the data and maintained on secure database servers. These datasets are used by MN EPHT staff to study health outcomes and exposure. Data reported to the public are summary data; only aggregate counts, rates and group statistics are public. Small numbers in tables that might be identifiable when combined with other information are suppressed according to data suppression rules. No identifiable individual health information is released to the public.



GOAL 2: ENSURE THAT ENVIRONMENTAL PUBLIC HEALTH DATA ARE ACCESSIBLE AND USED.



The MN EPHT program facilitates the dissemination of summary data collected for the public and all data users in an easily accessible format, in accordance with the state statute. This is to ensure that the data are easy to locate and are useful for meeting the program goals and mission. MN EPHT is unique in that environmental and health information maintained in a wide array of state programs are brought together and made publicly available in one place.

Some of the primary users of MN EPHT data include:

- Local citizens and elected officials seeking information about their communities to support local decision-making

- Local public health officials conducting health assessments or preparing grant applications
- Non-governmental organizations seeking data to support policy positions and actions
- Academic researchers using data for studying the relationships between environmental risk factors and health
- State disease and exposure prevention programs seeking data to target their activities and evaluate the effectiveness of programs

In addition to making the data easily accessible, MN EPHT provides a number of different ways of displaying and sharing the information to meet the needs of many data users. Published data reports and a state web-based information system are the two primary means for data dissemination.

MN EPHT publishes data reports

The publication of data reports in 2009 and 2010 is one way of disseminating data to the public.

Data reports are now published and posted on the MN EPHT website for the following topics:

- Asthma, COPD and Heart Attacks (Hospitalizations)
- Childhood Blood Lead Poisoning
- Community Drinking Water Quality
- Carbon Monoxide Poisoning

In accordance with the EHTB statute, each report characterizes statewide trends and geographic patterns of the data. When available, county level data and information on race, ethnicity and socioeconomic disparities are described. Health risk information and actions that individuals and health officials can take to reduce risk are provided along with links to other resources for more information. The reports also provide information about the limitations of the data and suggest ways in which the data can be improved.

Data reports are available on the MN EPHT Program web site: (<http://www.health.state.mn.us/tracking/>) and by

request, on CD and print copy. More reports are planned for publication in 2011.

MN EPHT provides web-based data access for the public

In September 2010 MN EPHT began testing a new web-based information system (or data portal) for disseminating health and environmental data on MDH's website. Starting in 2011, the system will provide access to public summary data (including basic counts, rates, charts and tables, as well as custom data queries) for all available MN EPHT public datasets.

The primary target audience in the first year of testing this system in 2011 will be city and county public health professionals. Local health professionals in Minnesota routinely gather and report relevant data to inform local health assessments, policy and planning activities, and to respond to questions from citizens.

Similar to the data reports, the data available on this system will offer several information options for users. For example:

- data sets are summarized in charts and graphs to show trends over geographic areas and time periods
- charts and graphs identify exposure, health disparities and populations most affected
- custom queries allow users to select counties or demographic factors for viewing and comparing the data.

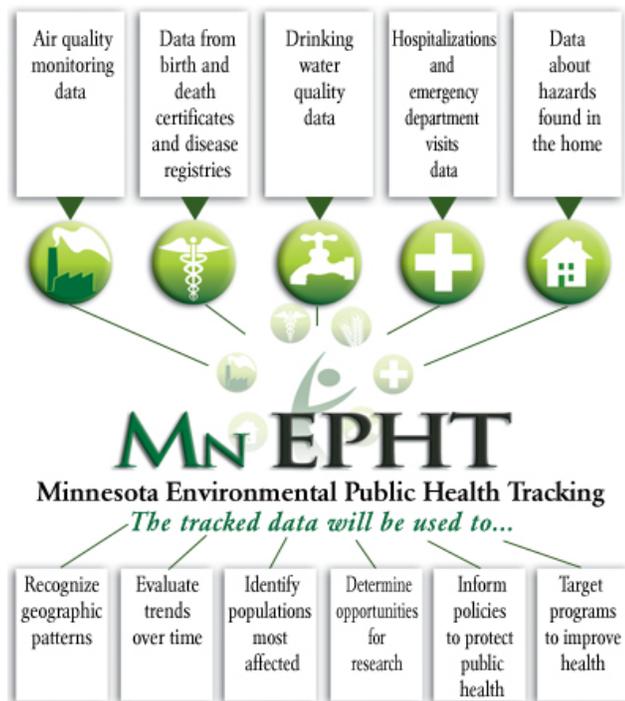
MN EPHT advances MDH capacity for mapping and display of environmental public health data

In recent years, geographic information systems (GIS) technology and training have led to increased understanding of methods for mapping of public health data, and for interpreting information on maps. In 2011, an enhancement to the data portal will add new mapping capability for custom data displays, including environment, health and demographic (census) data. MN EPHT staff are part of a new national team that is working to advance the methods for

geospatial analysis and display of health and environmental data.

MN EPHT data are available on the national EPHT website

The national EPHT network launched a web-based electronic network for nationally consistent health and environmental data in July 2009. Several Minnesota summary datasets were submitted to the CDC in 2010 and will be available on the national portal. This will allow for cross-state comparisons, where appropriate.



Meeting data users’ needs in the future

Plans for the future enhancement of data access include:

- New data content areas and web-based portal display features
- Public outreach and training for local public health officials and other data users to promote data use
- A secure portal, providing password-protected access for authorized users to custom data sets on a case by case basis (e.g., upon request and review by data stewards via application to the MN EPHT portal)



GOAL 3: BUILD AWARENESS, KNOWLEDGE AND SKILLS AMONG POTENTIAL DATA USERS RELATED TO ENVIRONMENTAL PUBLIC HEALTH TRACKING IN ORDER TO INFORM ACTIONS TO IMPROVE PUBLIC HEALTH.



EPHT communications and outreach activities are designed to ensure that people are informed and skilled in accessing environmental public health data to meet their needs. In 2009-2010 MN EPHT used multiple approaches, tools, and venues to communicate information with key audiences, including: the public, the Minnesota Legislature, local public health professionals, state agencies (MPCA, MDA, MDH), academia (UMN), and non-governmental organizations (MN American Lung Association). These activities have demonstrated a high level of interest among diverse groups for information about environmental public health tracking and biomonitoring, and highlighted the importance of providing credible, accurate and understandable health and environment information to the public.

The following is a summary of key communications and outreach activities conducted in 2009-2010, and highlights of plans to enhance/expand outreach activities in 2011.

Meetings, Presentations & Conferences

To build awareness about the tracking and biomonitoring data available, MN EPHT provided over 25 presentations/displays for audiences in 2009-2010, including: the University of Minnesota (School of Public Health), State Community Health Services Advisory Committee, the Maternal and Child Health Advisory Task Force, the MPCA Air Issues Seminar Series, and conferences sponsored by the Statewide Health Improvement Program and School Nurse Organization of Minnesota.

Brownbag Seminar Series

In 2010 MN EPHT initiated a series of brownbag seminars to foster communication and collaboration across state programs on emerging health and environment issues in Minnesota.

Seminars topics in 2010 included:

- Climate Change: a joint presentation with the MDH Office of Emergency Preparedness and the MDH Environmental Health Division
- Biomonitoring: a joint presentation with the MDH Public Health Laboratory
- Geovisualization, GIS and Chronic Disease: a joint presentation with the MDH Heart Disease and Stroke Prevention Program.

MN EPHT will expand this series in 2011 with presentations available via webinar (recorded) and with public announcements via MN EPHT's web site and email subscription service which has over 600 subscribers.

MN EPHT responds to public inquiries

MN EPHT established a toll-free phone number and email account for handling public inquiries about tracking and biomonitoring. Through these mechanisms, the public is able to easily access MN EPHT staff to request additional information and/or data.

Collaborating with a national network

In 2009-2010 MN EPHT collaborated with the CDC and other states in the National EPHT Network on a variety of communications and outreach activities.

MN EPHT participated in national workshops to share information about communications materials/tools, and to evaluate the effectiveness of outreach methods. MN EPHT also co-presented at a national webinar to share lessons learned for establishing a tracking program (sponsored by the National Association of City and County Health Officials and CDC).



GOAL 4: BUILD COLLABORATIONS TO ENHANCE ENVIRONMENTAL PUBLIC HEALTH TRACKING IN MINNESOTA.



In Minnesota Statutes 144.996, subdivision 1, paragraphs (2), (3), and (4), clauses (iii), MDH is directed to facilitate dissemination of data to researchers and to identify core priorities for research and surveillance. MDH is further directed to assess the feasibility of integrating disease data with indicators of exposure to selected environmental hazards, including biomonitoring data. A significant outcome of this work is to fully explore the limitations in the data and develop new analytic methods.

MN EPHT supports academic partners

The National EPHT network announced awards in 2010 for academic partners to conduct research that will use data from the Tracking network. MN EPHT is collaborating on two of these projects by facilitating data access:

- University of Illinois-Chicago investigators are conducting a feasibility study across 8 upper Midwest states for linking data on agricultural (e.g., atrazine and nitrates) contamination in drinking water with adverse health outcomes in children.
- University of Medicine and Dentistry New Jersey investigators are developing methods for linking air quality data with state cardiovascular and birth outcomes.

MN EPHT builds state capacity to monitor the impacts of climate change on public health

MN EPHT is collaborating to implement a 2010 CDC-funded program at MDH by developing new methods for tracking changes in the frequency of heat-related hospitalizations and deaths. With these data, public health officials will be better informed for planning and responding to the anticipated public health consequences of climate change.

THE MINNESOTA ENVIRONMENTAL PUBLIC HEALTH TRACKING PROGRAM: DRIVING PUBLIC HEALTH ACTIONS

Measuring our success:

From data to public health action

Any data surveillance system is only useful in as much as it is used. The ultimate goal of collecting and sharing public health data is to identify health priorities that can provide the basis for actions to improve public health.

In 2009 and 2010, the MN EPHT program has made significant progress towards achieving this ultimate goal. Some of the key accomplishments are described below.

Tracking the Impact of a Statewide Carbon Monoxide Alarm Law

Each year, unintentional carbon monoxide (CO) poisonings result in several deaths and hospitalizations in Minnesota. The cold Minnesota winter season is prime time for CO poisonings. In 2007-2009 Minnesota took an important step towards prevention by implementing a state law requiring CO alarms in all single family homes and multi-dwelling units. However, without a tracking system for CO poisonings, the Minnesota Department of Health had no means to evaluate the impact of the law on the occurrence of CO poisonings.

Minnesota EPHT collaborated with the National Tracking Network to develop data and measures for CO poisonings. These data were summarized in a tracking report and press release that resulted in local media coverage about CO poisoning prevention. In addition, MN EPHT, in partnership with the state Behavior Risk Factor Surveillance System (BRFSS), initiated collection of data on the number of Minnesota homes that have CO alarms.

The timing of the implementation of the CO alarm law and the establishment of data and measures for CO has created the perfect environment in which tracking can be used to evaluate trends in CO poisoning and the impacts of policy changes. MN EPHT will use CO tracking and Behavioral Risk Factor data to

assess the effectiveness of the state CO alarm law. Tracking data also will be used by Minnesota indoor air and healthy homes programs to target and evaluate outreach activities to improve public health.

Using Tracking to Inform Communities about the Built Environment and Health

The Central Corridor Light Rail Transit (CCLRT) line currently is under development between Minneapolis and St. Paul, Minnesota. This project presented a unique opportunity for the Minnesota Department of Health (MDH) to work with local communities to identify and evaluate health and environment issues early in the CCLRT planning process.

Populations living near the CCLRT line (e.g., along University Avenue) expressed concerns about health disparities and several environmental health issues, including: asthma, air pollution and traffic, childhood blood lead poisoning, and contaminated lands (i.e., brownfields). While existing health and environment data had been collected in this urban area, the data were not systematically reported or easy for the public to access.

Minnesota EPHT collaborated with the National Tracking Network to develop data for tracking asthma (hospitalizations). These data were aggregated by zip code and placed in a map that was distributed, along with other health information, to local communities living near the CCLRT line. These data, ultimately, were used by MDH to inform the community, local government, and developers about ways that individuals and the community can reduce environmental health hazards.

Methods and data developed through this project may be used by Minnesota EPHT to assess how changes in the built environment (i.e., resulting from the CCLRT line), influence health and environment at the local level.

Tracking of chronic obstructive pulmonary disease builds partnership with Minnesota Chapter of the American Lung Association; informs disease prevention

Chronic obstructive pulmonary disease (COPD) is the fourth-leading cause of death in the US, and is an important cause of hospitalization and mortality in our aging population. In 2006, there were 9.5 million US adults with chronic bronchitis (4.3%) and 4.1 million adults with emphysema (1.8%).

Many states routinely collect COPD data (as a part of hospital discharge data sets); however, these data are not readily accessible to health professionals or the public. Given the magnitude of public health and economic impacts of COPD in the US, this is an important data gap in information that could be used to inform public health actions and policy.

In September 2010 Minnesota Environmental Public Health Tracking (MN EPHT) published state-specific data and measures for COPD hospitalizations (rates and counts) on the state tracking data portal. MN EPHT developed these data using methods that are consistent with the national EPHT network, so that they may be easily adapted by other states and at the national level. In addition, in 2009 Minnesota was one of a small number of states in the country to measure COPD prevalence statewide using the Minnesota Behavior Risk Factor Surveillance System. Together these data provide useful information to evaluate trends and spatial patterns over time, and to inform the public about important risk factors and public health actions.

MN EPHT currently is working with the Minnesota American Lung Association to use COPD data to educate health professionals and others about the impact of COPD in Minnesota. This activity resulted in additional media coverage of COPD in the state, and initiated discussions with key partners regarding mechanisms for raising awareness about this poorly recognized and underestimated public health issue. In addition, MN EPHT has shared

the COPD data and measures with other states and CDC as a potential future developmental area for the National EPHT Network.

Streamlining data sharing across state programs

Designing an efficient process that promotes appropriate public health data sharing and use while protecting data privacy is critical not only to the Tracking program, but serves the needs of other programs as well. MN EPHT's efforts to establish a series of data use agreements with multiple programs led the agency to design a more streamlined process for sharing data within the department; this is now being implemented.

Developing indicators to protect child health

Children are uniquely exposed to many social and environmental factors that are associated with adverse health outcomes (e.g., low birth weight, blood lead poisoning, infant deaths). However, the data needed to measure these outcomes are not easy to access, nor are the data integrated across different program and agencies.

Minnesota EPHT participated in a multi-program initiative at the Minnesota Department of Health (MDH) to develop and evaluate indicators of child health. MN EPHT epidemiologists shared the criteria used to select Minnesota-specific indicators for our state tracking program. MN EPHT's work helped to develop an integrated set of child health indicators that are available in the report, "Investing in Our Children: Indicators Project Summary."

Looking Ahead

Collecting and integrating data for public health analysis and disseminating the results to the public is an ongoing effort that will require sustained funding and authority. Funding reductions across health and environmental programs may lead to gaps in the data needed to inform policy decisions. MN EPHT will continue to seek out partnerships and resources necessary to maintain the utility of the Tracking system in serving the information needs of local communities, public health officials, policy makers, and individual citizens of the state.

MINNESOTA'S BIOMONITORING PILOT PROGRAM: PROGRESS REPORT

Biomonitoring: a valuable new tool for measuring environmental public health

Biomonitoring is the direct measurement of chemicals (or the products that chemicals break down into) in people's bodies – in their blood, urine, or some other body fluid or tissue. Biomonitoring can be a good way to determine a person's total chemical exposure from all sources (water, foods, consumer products, etc.) combined.

Biomonitoring technology has been developing in private and public health laboratories over the past 30 years. The Centers for Disease Control and Prevention (CDC) now routinely monitors levels of chemicals in Americans' blood and urine as part of the National Health and Nutrition Examination Survey (NHANES). For its latest report, CDC measured 212 chemicals in around 2,400 participants who represent the civilian U.S. population. These results are widely used by public health officials to determine the "average" American's exposure to chemicals.

Biomonitoring also measures whether public health programs and policies to reduce chemical exposures are making a difference. For example, the CDC has measured blood lead levels in children and adults since the 1970s, when leaded gasoline was being phased out. Biomonitoring results showed that blood lead levels decreased 10 times more than expected, providing convincing evidence that banning leaded gasoline successfully reduced lead exposure. Biomonitoring data have also documented declines in cotinine levels, a marker of exposure to tobacco smoke, with the advent of workplace and restaurant/bar smoking bans.

The national biomonitoring program does not provide data that can be used to measure exposure at the state, county or community level. Exposures to chemicals may differ by state or region because different industries, climate patterns, geographic features and population characteristics can affect exposures.

Currently, Minnesota is one of several states working to develop the capacity needed to implement state-based biomonitoring that will inform state and local public health programs and serve the needs of concerned communities. Minnesota's pilot program has been recognized as a model for other states by national organizations, including the National Conference of State Legislatures (NCSL).

Biomonitoring Pilot Program Objectives

In 2007, the Minnesota Legislature directed MDH to establish a biomonitoring pilot program and to conduct four pilot projects in communities likely to be exposed to environmental chemicals. Three of the chemicals were specified in the legislation (i.e., arsenic, mercury and PFCs); a fourth chemical was to be selected by MDH in consultation with the EHTB Advisory Panel (Minnesota Statutes 144.997, subdivision 1, paragraphs (1) to (3)). F

The primary objective of the MDH biomonitoring pilot program is to answer questions about the magnitude and range of exposure to specific chemicals in the selected communities. Pilot projects were designed to compare exposures in Minnesota communities to levels measured by the CDC among the general US population. With these comparisons, biomonitoring can determine whether selected Minnesota communities are exposed, on average, more or less than the US population.

Another objective of the pilot program is to build an infrastructure at MDH for implementing an ongoing biomonitoring program. MDH has added skilled chemists and environmental epidemiologists to the staff, and expanded training opportunities and resources across the agency to enhance organizational capacity. In the laboratory, the biomonitoring pilot program has helped MDH gain knowledge about the robustness and comparability of laboratory techniques, precision and accuracy of laboratory data, detection limits of analytical methods, and the integrity of aged biospecimens.

Although this was not a specific objective of the pilot projects, biomonitoring can identify individuals with elevated exposure above the community average. When a measured level has suggested a health concern, MDH has referred individuals for additional follow-up with a clinician. Further investigation of individual cases is then done to try to identify the source of the exposure. Such investigations have the potential to result in the discovery of new sources of exposure.

Biomonitoring guidelines are developed

In accordance with Minnesota Statute 144.997, subdivision 4, program staff, in consultation with the Advisory Panel, developed guidelines to inform decisions about the design and implementation of the four biomonitoring pilot projects. These guidelines define the primary purpose of the state’s pilot program as

providing information about the distributions and ranges of exposure to specific chemicals in the selected communities. The guidelines set standards for program implementation in the following areas: project design, privacy of information, informed consent, laboratory quality assurance and approval program, storage and use of stored specimens, communication of results, community acceptance, follow-up counseling, selecting appropriate reference values for data interpretation, and inclusion of children.

Overview of four biomonitoring pilot projects

The MDH biomonitoring pilot program has designed and implemented four pilot projects, summarized in Figure 3 below. These projects, when taken together, demonstrate a wide variety of biomonitoring project designs. The variation allows MDH to explore a range of approaches and to maximize its learning opportunities.

Figure 3. Comparison of four biomonitoring pilot projects

	Study population	Study community	Biospecimen/ Analyte	Likely source of exposure	Population sample	Recruitment goal
Minneapolis Children’s Arsenic Study	Children, 3-10 years old	Urban; geographic community	Urine/ total and speciated arsenic	Ingestion of residential soil contamination, diet, and other exposure routes	Random selection	100
East Metro PFC Biomonitoring Study	Adults, 20 years and older	Suburban; communities based on drinking water source	Blood serum/ 7 PFCs including PFOA, PFOS, and PFBA	Ingestion of contaminated drinking water, diet, and other exposure routes	Random selection	200 (100 from each of 2 communities)
Lake Superior Mercury Biomonitoring Study	Newborns	Rural; geographic community	Newborn dried blood spot/ total mercury	Maternal dietary exposure (fish consumption)	Total population meeting inclusion criteria	1,150 in Minnesota; 600 in Wisconsin and Michigan
Riverside Prenatal Biomonitoring Study	Pregnant women	Urban; clinic-based community	Urine/ Cotinine and Environmental phenols including Bisphenol A (BPA)	Diet and consumer product use (phenols); secondhand smoke (cotinine)	Total population meeting inclusion criteria; stratified by ethnicity	90 (30 from each of 3 ethnic communities)

Pilot Project: The Minneapolis Children's Arsenic Study

The Minneapolis Children's Arsenic Study was conducted in south Minneapolis, in neighborhoods where elevated levels of arsenic were detected in the soil of several hundred residences. The U.S. EPA conducted testing of the soil as part of an investigation of a former pesticide facility. The purpose of the project was to investigate whether children living in the community and/or in households with contaminated soil have elevated levels of arsenic when compared to the level considered "normal" from a health viewpoint and compared to levels found in the U.S. population.



Participation in the study was limited to children, ages three through ten. Children were selected for this project because they were more likely to be exposed to arsenic from playing in the soil and to get soil in their mouths. In addition, children can be exposed to arsenic through some foods (such as fish, rice and rice milk), treated wood used on decks and playgrounds, pesticides and fertilizers used in the home, traditional and herbal medicines, and dietary supplements.

Arsenic was measured in children's urine, which is considered the most reliable way to measure arsenic. However, because arsenic does not stay in the body for very long and is mostly excreted

within several days, an arsenic measurement in urine is just a snapshot of recent exposure to arsenic through the soil and other sources.

Design and recruitment: Recruitment efforts first focused on 833 households for which EPA records indicated elevated levels of arsenic in the soil. Recruitment was later expanded to all households in the study area, which added over 2,600 potentially eligible homes. The project successfully recruited 65 children within the study period, including 40 from the households with soil arsenic levels above 20 parts per million (ppm). Each child, with parental help and informed consent, provided two urine specimens.

Community outreach: Information about the project was sent home with school children in the project area; posted at neighborhood parks, libraries and other gathering places; and listed in community newspapers. Presentations about the project were made to community organizations, a display booth was staffed at community events, and a formal community meeting was held to describe the project and solicit input from residents. City public health and environmental staff, local elected officials, and neighborhood civic organizations were also consulted.

In addition to community outreach, project staff contacted clinics in the area with information and made presentations to medical providers at three of the clinics. This helped ensure that providers in the area were aware of the project and could provide their patients with appropriate testing, follow-up care and counseling.

Laboratory analysis: The MDH Public Health Laboratory measured total arsenic levels in the urine samples according to methodology developed by the CDC for all participants. In addition, when participants' arsenic levels were above 15 $\mu\text{g/g}$ creatinine, the urine specimen was further analyzed to determine how much of the arsenic was organic (generally a safe form of arsenic from foods) and how much was inorganic (a potentially harmful form of arsenic).

Communication of individual results: Parents of children participating in the study who requested to receive their children's results have received them, along with information to help interpret their result, identify possible ways their children are exposed to arsenic, and take steps to reduce the exposure. Parents of 3 children who had levels of arsenic above the CDC action level (50 ug/L) were provided with information and encouraged to consult a medical provider for retesting.

Data analysis and summary results: MDH staff conducted data analysis and the Advisory Panel was consulted on analytic methods, results presentation, interpretation and recommendations. MDH provided a written summary of the community results and recommendations both in a technical report and in a brief community report (see Appendix A). A summary of the project results was also presented at two community meetings where input was given on further follow-up in the community.

Conclusions: Children's arsenic levels in the community were elevated above the US national average but were comparable to levels found in similar urban communities and below a level of health concern. Further analysis examined the relationship between past soil levels (measured by the EPA at the home) and arsenic levels in childrens' urine, and found no correlation. Continuing health education of parents on ways to prevent children from being exposed to arsenic was recommended.

Pilot Project: The East Metro Perfluorochemicals (PFCs) Study

The East Metro Perfluorochemicals (PFCs) Biomonitoring Study was conducted in two communities in Washington County, where the drinking water is contaminated with PFCs. The primary purpose of the project was to determine whether the communities as a whole have elevated levels of PFCs when compared to the national average, and similar exposed communities.



The two communities were defined not by geographic boundaries, but by their drinking water source. The first community is defined as households that are served by the Oakdale municipal water supply. The second community is households with private wells contaminated with PFCs in Lake Elmo and Cottage Grove.

These communities were selected because testing has shown that the drinking water in these communities is contaminated not only with PFBA (which leaves the body relatively quickly due to its short half-life) but also with PFOA and PFOS (which have half-lives of three to six years and, as a result, stay in the body much longer).

This study was limited to adults, ages 20 and older. Adults are more likely to have been exposed to the contaminated drinking water over many years while living in the community. Adults were also selected as the study population for this project because participation involves having blood drawn from a vein in the arm, an invasive medical procedure with no health

benefit, which posed ethical obstacles to including children in the pilot.

PFCs were measured in blood serum, which is considered the most reliable way to measure PFCs.

Design and recruitment: Eligible households were identified and randomly selected from Oakdale city water billing records and MDH well sampling results. To be eligible for the study, adults in selected households must have been living at their current residence before the PFCs were detected in the water.

For the Oakdale municipal water community, a total of ninety-eight participants completed the study. In the Lake Elmo and Cottage Grove private well community, ninety-eight participants also completed the study. Participants were directed to one of two Health East clinics in or near the study area to have their blood drawn. Both were under contract to MDH.

Community outreach: To involve community members and gain community acceptance, staff met with county public health and environmental staff and city administrators and local elected officials about the project. A series of formal community meetings was held and a display booth was staffed at meetings held in the community. Local officials assisted in getting the word out to residents through direct mailings, newsletters and websites. The local newspapers ran stories about the project, and staff were interviewed for a show on a local cable station.

In addition to general community outreach, efforts were made to inform medical providers in the study area about the project. Project staff conducted three presentations at medical clinics in or near the project area. This included an overview of the current research on the possible health effects of PFCs and suggestions for appropriate follow-up care for individuals who are concerned about their exposure to PFCs.

Laboratory analysis: The measurement of PFC levels in the blood samples was performed at the MDH Public Health Laboratory according to methods developed by the CDC and by the MDH Public Health Laboratory. A total of seven PFCs were measured; these are the same PFCs that were measured in the water in the east metro area:

- PFBA Perfluorobutanoic acid
- PFPeA Perfluoropentanoic acid
- PFHxA Perfluorohexanoic acid
- PFOA Perfluorooctanoic acid
- PFBS Perfluorobutane sulfonate
- PFHxS Perfluorohexane sulfonate
- PFOS Perfluorooctane sulfonate

Communication of individual results: All participants requested and were mailed their results. Values were compared to results obtained through the CDC National Biomonitoring Program. Participants were provided with information to help them interpret their results. MDH provided a medical consultant for responding to questions and participants with concerns about their health were advised to consult their health care provider.

Data analysis and summary results: Environmental epidemiologists at MDH conducted data analysis and the Advisory Panel was consulted on the results, interpretation and recommendations. MDH provided a written summary of the results both in a technical report and in a brief community report (see Appendix B). A summary was also presented at two community meetings.

Conclusions: Project results indicated that three PFC compounds (PFOA, PFOS, and PFHxS) were present in the blood of all participants and that average levels in the community were elevated above the US national average. Levels were similar or lower when compared to other communities with known drinking water exposure. A follow-up analysis to measure the relationship between private drinking water well concentrations and serum levels found that

drinking water levels are correlated with serum levels.

Further study to measure changes in blood levels over time was recommended to evaluate the effect of public health actions taken to remove the exposure to contaminated drinking water. These actions included the installation of a carbon filtering system on the Oakdale municipal water supply, the provision of alternative water sources for private well owners (bottled water, whole-house carbon filters, and municipal hook-ups.)

A follow-up study to measure changes in the blood levels of project participants (2 years after the original study was done) was initiated in November 2010. Specimen collection was completed in February 2011 and results are expected later in the year.

Pilot Project: The Lake Superior Mercury in Newborns Study

The Lake Superior Mercury in Newborns Biomonitoring Study is being conducted in collaboration with state newborn screening programs in Minnesota, Wisconsin and Michigan. The purpose of the study is to measure mercury exposure in newborns. The study also evaluates a newly developed laboratory method for biomonitoring using dried newborn blood spots.

The Minnesota study population consists of infants born to mothers living in northeastern Minnesota, near Lake Superior. While at this time no data indicate whether people living in the Lake Superior area are more likely to be exposed to mercury than people living in other parts of the state; all newborns are potentially exposed to mercury through maternal fish consumption.

Mercury is being measured in the residual portion of the newborn dried blood spots collected by the MDH Newborn Screening Program. Laboratory analysis for this project was funded by the U.S. Environmental Protection Agency.

Design and recruitment: Recruitment began in Minnesota in November 2008 and continued through November 2010. Newborns were identified from the Newborn Screening database at MDH. About 10% of newborns were excluded from the study due to pregnancy complications, or if the infants died or were born with certain health problems. This was done to avoid causing undue stress to the parents. An additional 25% of eligible newborns were excluded due to insufficient quality of the blood spots for analysis.

Mothers of eligible newborns were mailed a letter and consent form explaining the project and inviting their participation. Local public health departments in the study area assisted with recruitment. A total of 1,130 Minnesota newborns were enrolled with parental consent. Over half (56%) of parents contacted did not respond or

chose not to participate. Dried blood specimens were collected for mercury analysis from the newborn screening laboratory.

Community outreach: MDH staff met with local, county and tribal health officials in the project area to inform them of the project and to solicit their input on developing a communication plan. Over the course of the study, staff distributed informational materials on mercury exposure to community members, medical providers and local public health officials.

Laboratory analysis: The measurement of total mercury levels in the newborn blood spots is being performed at the MDH Public Health Laboratory according to a novel methodology adapted from the CDC by MDH and Utah public health laboratory scientists.

Communication of individual results: Because the blood specimens collected for this project are anonymized (information that can identify the individuals is permanently removed) prior to analysis in the laboratory, participants will not receive their individual results. Potential participants were notified of this fact during the recruitment and informed consent process.

Data analysis and summary results: Analysis in the laboratory is currently ongoing. A separate report describing the results of the entire Lake Superior Mercury Biomonitoring Study is expected in 2011.



Pilot Project: The Riverside Prenatal Biomonitoring Study

The Riverside Prenatal Biomonitoring Study is an ancillary project to a research study at the University of Minnesota. The project measures pregnant women's exposure to a class of chemicals called environmental phenols, which are found in certain plastics, cosmetics and toiletries, and to cotinine, which is an indicator of exposure to secondhand smoke. These chemicals were selected because of concerns that they may affect fetal development.

Project participants are pregnant women who obtained prenatal care at one of two specified clinics and who planned to give birth at the University of Minnesota Medical Center, Fairview (Riverside Campus) in Minneapolis.

The selected chemicals are being measured in urine, which was the most feasible specimen that could be obtained given the study design. All of the chemicals that were selected are appropriate to measure in urine.

Design and recruitment: All pregnant women who were enrolled in the UM study were eligible and invited to participate by mail. Efforts were made to include an equal number of Latina, African/African-American, and white women. A total of 66 women agreed to participate and provided a single spot urine specimen using a collection kit that was sent to their homes. Recruitment goals for obtaining equal numbers within three ethnic/racial groups were not met due primarily to limitations within the selected clinic population and changes in recruitment strategies for the UM study.

Community outreach: Project staff contacted local health officials to inform them about the project and to solicit their input. Meetings with clinic representatives were held to explain the project. MDH will consult with community groups and organizations who address environmental concerns and health risks for pregnant women when the results are available to plan additional communications.

Laboratory analysis: The measurement of environmental phenols in the urine samples is being performed at the MDH Public Health Laboratory according to methodology developed by the CDC. The specific environmental phenols that will be measured include the following:

- Bisphenol A
- Triclosan
- Benzophenone
- Methyl paraben
- Ethyl paraben
- Propyl paraben
- Butyl paraben

The measurement of cotinine in the urine was performed by a commercial lab paid by MDH.

Communication of individual results: Because the urine specimens collected for this project are de-identified (information that can identify the individuals is maintained by the University and not provided to MDH), participants will not receive their individual results from MDH. Potential participants were notified of this fact during the recruitment and informed consent process. Participants may request results through the University with special permission.

Data analysis and summary results: Cotinine results were presented to the Advisory Panel in June, 2010. Analysis of environmental phenols in the laboratory is ongoing. A separate report describing the complete results of the project is expected in 2011. Results will be compared to a national average to determine whether pregnant women in this community experience exposures that are different from or the same as women of child-bearing age in the United States.

BIOMONITORING PILOT PROGRAM: SUCCESSES AND CHALLENGES

MDH has learned a number of valuable lessons and staff have documented both the successes and challenges of carrying out the biomonitoring pilot program for the state to help guide future biomonitoring efforts. A few highlights are provided below.

Pilot Project Successes:

- Program staff established many community connections that were vital for establishing a basic level of trust and acceptance within the community and for ensuring that community members were well informed.
- Coordination with experts across multiple public health disciplines, including epidemiology, toxicology, laboratory science, and communications was key to successful project design and execution.
- To guide decisions about the design and implementation of the four pilot projects, the program developed guidelines that address the science and best practices for biomonitoring at MDH. These guidelines, developed in consultation with the Advisory Panel, proved to be an invaluable resource for informing decisions during project planning.
- The four pilot projects have allowed program staff to learn about effective participant recruitment and enrollment methods in a variety of settings. Recruitment strategies included fliers, community meetings, mailings, phone calls, and door-to-door visits. Recruitment challenges differed depending on the specific communities (which included a diverse, multi-lingual urban area, a rural area and a suburban area) and how engaged and knowledgeable the community was about environmental issues.
- Collaborations with other researchers or programs that recruit subjects and/or collect specimens for another purpose (eg. Lake Superior Mercury and Riverside Prenatal

projects) reduced the expense of biomonitoring projects.

- Due to expanded laboratory capacity at the MDH Public Health Laboratory, skilled chemists are now able to perform complicated analyses of PFCs, mercury, and speciated arsenic in human specimens.
- Biomonitoring supports the maintenance of state-of-the-art instrumentation in the laboratory, useful not just for biomonitoring, but also for other chemical analyses important for public health protection, including chemical emergency response.

Pilot Project Challenges:

- The process for developing laboratory methods for analyzing environmental chemicals in human biospecimens is time-consuming. Systems for quality assurance and control of laboratory results typically include internal and external validation studies, proficiency testing, and federal certification. Because in many cases the lab methods for biomonitoring are new, these systems may not be readily available for the specimens and chemicals of interest. Published lab methods, when available, are not always up to date, and specialized training for laboratory staff has been needed to meet this challenge.
- Conducting biomonitoring ancillary to another program or research study using specimens collected for another purpose did lower project costs (e.g., Lake Superior Mercury and Riverside Prenatal projects) but program staff had limited control over changes in study protocols, recruitment strategies and communications with participants as a result. This trade-off, which can compromise program objectives, guidelines and directives under state statute, should be considered when collaboration with an existing study or program is proposed.

- One of the greatest challenges has been communicating with biomonitoring study participants and communities about their results in a meaningful way, particularly when human health effects of the chemicals being measured are largely unknown. In response to this challenge, program staff have explored different ways of explaining what the results mean for health. Staff have routinely provided advice to individuals on actions they can take to prevent exposure and developed educational materials for a wide variety of audiences.
- Another challenge for public health practitioners is to identify and implement the appropriate public health responses that are needed as a result of new information learned from biomonitoring. When and how to take action to protect public health in response to biomonitoring results is still uncertain and an area where new public health policy development is needed. The development and use of appropriate reference values from valid comparison populations is needed. Reference values based on a US population sample and other published literature may not be appropriate for state and target group comparisons and data interpretation.
- The Lake Superior Mercury in Newborns project raised awareness of the sensitivities of using stored newborn screening spots. New rules governing an informed consent process for use of the spots were implemented when the project began. Under the informed consent process, less than 45% of the target population was enrolled, which limits the inferences that can be drawn for describing exposure among newborns. Biomonitoring, like all public health surveillance activities, must address the challenge of this conflict between the need for informed consent and the need for a scientifically valid population-based exposure measurement to inform public health protection and policy.

THE VISION FOR BIOMONITORING IN MINNESOTA

While the pilot phase of the biomonitoring program has been underway, MDH has pursued the development of recommendations for an ongoing state biomonitoring program in Minnesota. A key consideration was to ensure that public health practice goals consistent with our mission to protect and maintain the health of all Minnesotans are met and that the program would use public resources wisely.

The following strategies and recommendations build on the experience gained through the pilot projects and were developed through a strategic planning process that involved state agency staff, Advisory Panel members, the general public, interviews with other state and federal biomonitoring programs, and other stakeholders.

Vision and goals for a Minnesota biomonitoring program

As a first step, program staff and Advisory Panel members worked together to establish a vision statement and goals for an ongoing program.

Vision

Minnesota's biomonitoring program will have the capacity to accurately and efficiently measure and track exposures in people from the environment, and to protect public health by improving the understanding of risk and disease so that Minnesotans will lead healthier lives and live in safer environments.

Specific elements of this vision were further defined through the strategic planning process:

Biomonitoring data are collected and effectively used to protect public health

Biomonitoring will protect the health of all Minnesotans by measuring and tracking the concentrations of chemicals that get into people's bodies from the environment. Knowing more about people's exposure to chemicals will help state and local officials, advocacy groups, industry, and decision makers better determine the health risk and take actions that can best help to reduce risk, promote health, and eliminate disparities.

Risk and disease are better understood

Biomonitoring will provide a base of information that will help public health scientists study the connections between environmental hazards and disease. Public health officials will better understand and be able to share new information with the public, and will be better able to track progress in improving public health.

Minnesotans will know more about the risks of chemicals in their environment in order to make wise choices to promote their own health and the health of their communities.

Adequate capacity and resources are maintained

If adequate resources become available, Minnesota's biomonitoring program will have the capacity and expertise needed to measure environmental chemicals in people's bodies accurately and efficiently. The program will be a resource for public health officials to use for providing a scientifically grounded response to the public health concerns of communities in Minnesota.

Goals

The core goal of Minnesota's ongoing biomonitoring program is to monitor the distribution of exposure to designated chemicals in the environment among the general population of Minnesota and communities within the population in order to:

- **Track trends in exposure over time.**
- **Identify exposure disparities and sub-populations who are vulnerable to exposure.**
- **Assess the need for public health interventions.**
- **Evaluate the effectiveness of statewide and community-level interventions and policies that are implemented to reduce exposure.**

Other important benefits of ongoing biomonitoring are expected to include:

- Enhanced investigations of sentinel exposures and emerging contaminants.
- Better information about exposures in response to community concerns.
- More complete data about exposures to support research studies that measure the association with health outcomes and identify exposure sources.
- More complete data about exposures to support the establishment of health-based criteria for regulating chemicals in the environment.

Although the goals of the program do not specifically address rapid response to emergency events, having a base biomonitoring program in place helps develop and maintain needed infrastructure for MDH to respond to chemical emergencies.

MDH biomonitoring program goals do not include the conduct of research for the purpose of advancing scientific knowledge. But data generated through the program can be used to

support research collaborations. When integrated with exposure and disease data, biomonitoring has potential to reveal new knowledge about the relationships between chemical exposure and chronic diseases.

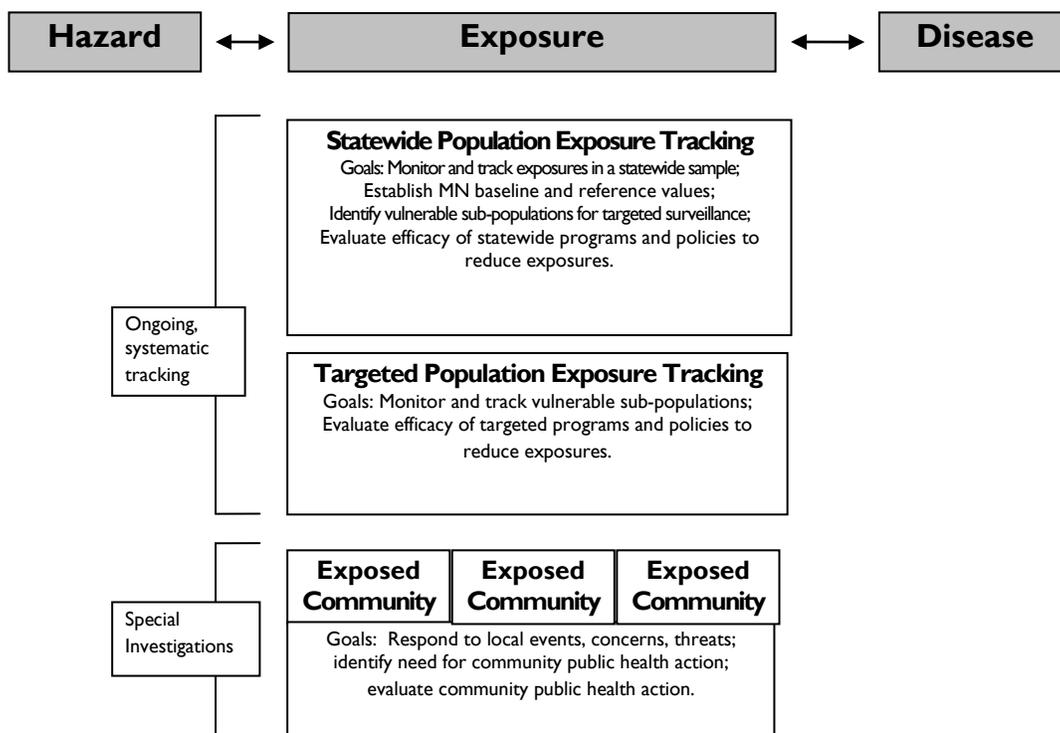
Three approaches for ongoing biomonitoring

To design a program that would meet the identified goals described above, a comprehensive model for a state biomonitoring program was developed that includes three distinct approaches to biomonitoring (see Figure 4 below):

- Statewide Population Exposure Tracking
- Targeted Population Exposure Tracking
- Special Investigations

Each approach helps to achieve a different set of goals. A comprehensive state program designed to achieve all of the stated goals would include all three components. However, the state may decide to do only one or two components as resources permit. The benefits and challenges of each of these approaches were reviewed and are described in text that follows.

Figure 4. Three Approaches for a Statewide Biomonitoring Program for Monitoring Exposure in the Hazard-Exposure-Disease Continuum



Statewide Population Exposure Tracking

The broadest, most comprehensive approach to biomonitoring would be a program to monitor and track trends in exposures to chemicals over time in a representative sample of the state population. This approach is consistent with a broad range of public health surveillance activities that observe temporal and geographical patterns in order to guide disease prevention and control programs.

Because an ongoing tracking approach to biomonitoring would involve measuring the same chemicals in Minnesotans at different points in time, this approach could also be used to evaluate the efficacy of statewide programs and policies enacted to reduce exposure to chemicals. The data can also be analyzed for the identification of vulnerable sub-populations that might benefit from further investigation and/or targeted public health intervention.

Strengths of a statewide exposure tracking approach

Ongoing, systematic collection of biomonitoring data using a statewide sample has the potential to achieve the greatest number of objectives for realizing our program's vision and purposes for all Minnesotans. The program could initially focus on a limited number of chemicals that are judged to be most important to Minnesotans and be expanded over time. It has the potential to measure a broader spectrum of chemicals because (with informed consent for such additional use) specimens can be banked in the laboratory for later analyses.

With this approach, new specimens could be collected on a cycle of three to five years and in different regions of the state, which would allow adequate time for planning, collection and analysis of specimens, and data analysis, and would spread costs out over several years. Because the sampling protocols would be consistent across time, the creation of new protocols, project materials, and approvals would not be needed with each repeat survey, thus

providing significant cost savings in subsequent years.

Statewide biomonitoring would provide relevant and timely population-based reference data for the general population of Minnesota that can be used for comparing and interpreting measurements in community investigations. Currently, national biomonitoring data collected by the CDC (often several years in the past) are used to estimate the exposure of Minnesotans.

Biomonitoring data collected on an ongoing basis have the greatest potential to be integrated with the state's Environmental Public Health Tracking (EPHT) program and for supporting the work of researchers investigating health impacts. Tracking exposures using the same temporal and geographic scales (state, county, zip code) as chronic disease tracking allows for data integration and creates opportunities to study the relationships between chemical exposures and health.

Statewide exposure tracking, if implemented, could be used to measure whether statewide policies and programs to reduce exposure to environmental contaminants are effective. For example, ongoing biomonitoring of perfluorochemicals could be useful for evaluating whether actions now being implemented to remove the chemical from drinking water supplies are making a difference.

Challenges of a statewide exposure tracking approach

Although this statewide approach is the most comprehensive for meeting program goals, there are a number of challenges to implementation. The most significant challenge to a statewide program based on ongoing exposure tracking is the relative insecurity of ongoing funding, and the need to weigh this cost against competing public health priorities. Strategies to address this challenge are needed.

Funding challenges could potentially be addressed through identifying key partnerships

and programs that could provide leverage and help to sustain the program. The laboratories, for example, would need sustained funding to support trained chemists who develop and perform new analytic methods and to maintain state-of-the-art analytical instrumentation. Federal funding partners, such as the CDC, will be important to sustaining laboratory capacity.

Another strategy that could be implemented for controlling costs is to limit the number of chemicals tested to a few high priority chemicals of concern, and to extend the time period between repeated surveys.

Partnerships are needed to ensure the most cost-efficient means of enrolling participants and

collecting specimens. Enrollment conducted in partnership with other state health surveys can reduce the costs of the program. One of the biomonitoring pilot projects, the Lake Superior Mercury Biomonitoring Project, was able to increase enrollment through partnership with local public health agencies. Several states have used specimens already collected for other purposes for biomonitoring, where permitted by applicable law. The New York City biomonitoring program (see box below) and the National Biomonitoring Program at CDC are both using specimens collected in partnership with established health and nutrition examination surveys (HANES) with the informed consent of survey participants.

Population Exposure Tracking (City-wide) Example: New York City Biomonitoring

In New York City, a biomonitoring program was first implemented in 2004 and was conducted as part of a citywide health and nutrition exam survey (HANES). NYC HANES assessed many health variables, including smoking status, depression, body mass index, blood pressure, cholesterol, diabetes, and other health-related outcomes in addition to chemical exposures. Though clearly not a statewide example, the NYC program is an example of biomonitoring that is conducted on a population-wide basis.

As part of the survey, 1,811 participants provided a blood and urine sample. The biospecimens were analyzed for the presence of chemicals thought to be of particular concern to people in New York City: urban pesticides (metabolites of organophosphates and pyrethrins/pyrethroids), cotinine (a marker for exposure to tobacco smoke), and heavy metals (lead, cadmium and mercury).

Because the survey was designed as a population-based, representative, random sample, these measurements could be used to determine 1) how New Yorkers' exposures were different than the nation as a whole, 2) whether exposures differed among demographic sub-groups, and 3) what characteristics were associated with higher and lower exposures.

Results from the biomonitoring program brought about important public health actions to reduce exposures to chemicals. For example, high mercury levels among those born in the Dominican Republic led to the discovery of illegally imported skin-lightening creams containing mercury. Higher levels of mercury were also found in those who self-identified as Asian, most likely due to fish consumption. These discoveries in turn led to public health actions, such as product embargos, expanded inter-governmental oversight of mercury in fish, and education campaigns for physicians and the public about fish consumption.

Targeted Population Exposure Tracking

Another approach under consideration would be to implement ongoing tracking of exposures to chemicals in one or a few targeted sub-populations. Similar to the statewide population exposure tracking approach, this approach, if implemented, would use systematic surveillance strategies for repeated sampling in the target group. The goals would be to monitor and track trends and observe geographic and demographic patterns in exposure in the target group, and to inform and evaluate exposure prevention programs in that group.

Targeted sub-populations would need to be identified according to a set of criteria, such as populations that are particularly vulnerable to chemical exposures or their effects. This could include groups such as women of child-bearing age and young children, people of a particular cultural or economic background, people who are vulnerable due to special medical conditions, or workers exposed in certain occupations.

Another targeted approach is to focus on one or more selected geographic areas (counties or cities) to represent populations throughout the state. This approach could be more cost effective than statewide exposure tracking and could potentially be expanded in future to include more geographic areas as more resources are identified.

Strengths of a targeted population exposure tracking approach

This approach preserves many of the benefits of statewide exposure tracking but reduces the scope and cost. Program goals could be achieved but would be limited to the targeted population. Repeated sampling could be scheduled every 3-5 years and limited to selected chemicals to reduce cost. The approach could also be used to build and maintain laboratory capacity to address emerging contaminant. The data could potentially serve as a reference for special investigations in the target population, and could be integrated with other disease and

exposure data in the Environmental Public Health Tracking system.

A targeted population exposure tracking approach could provide greater opportunities for partnerships and collaborations with other programs and organizations who share an interest in a particular sub-group of the population. MDH leadership has identified programs and initiatives that are focused on the protection of the health of children and the prevention of health disparities as key goals of the Department. Biomonitoring, conducted in collaboration with these initiatives, offers a potentially powerful tool for evaluating the efficacy of targeted programs and policies designed to reduce risk factors and prevent disease in accord with these Department priorities.

Challenges of a targeted population exposure tracking approach

Selection of a target population, chemical, or geographic area would likely involve a formal process for gathering background information, engaging stakeholders and establishing clear criteria for guiding decisions and priorities. This selection process would potentially add to the planning resources needed in the first year of the program.

Chemical selection could be challenging for biomonitoring programs because of the large number of chemicals and the scientific uncertainties in understanding health effects. In Minnesota, past decisions on chemical selection have focused on such criteria as public health impact (prevalence and toxicity), public concern, the likelihood of interpretable results and actionable findings.

Because the scope would be limited to a target group, it would not be possible to generalize the findings to other groups in the state.

Targeted Population Exposure Tracking Example: Minnesota's Blood Lead Information System

Minnesota's Blood Lead Information System monitors lead testing activities and tracks the occurrence of elevated blood lead cases in children in the state and is an example of how biomonitoring measurements can be conducted within targeted populations perceived to be at greater risk for or from chemical exposures.

Children living at or below the poverty line in older housing are at greatest risk for lead poisoning. National studies have shown that Medicaid-enrolled children are three times more likely to have elevated blood lead levels than non-enrolled children. The MDH Lead Program found that children enrolled in Minnesota Health Care Programs (MHCP) had higher lead poisoning rates than non-MHCP children, from 2004 to 2007. Since not all Minnesota children have a high risk for lead exposure, targeted screening (testing children at high risk) is recommended for most areas of the state, rather than universal screening (testing all young children).

In Minnesota, healthcare providers test for lead poisoning in children and adults by drawing blood and submitting the specimen to a laboratory for analysis. Laboratories conducting the blood lead analysis are required by state statute to report the lead level and additional demographic information to MDH. The reported data are private and are used by state and local public health officials for identifying children and pregnant women with elevated blood lead levels. Once identified, public health staff educate families on the hazards of lead in their home environment and work to help lower their blood lead levels. Analysis of the blood lead data on an aggregate level is used for identification of areas throughout the state where children may be at higher risk for lead poisoning and also for development of state screening guidelines.

Special Investigations

Special investigations measure chemicals in communities where specific exposures are suspected or known to have occurred, often in response to a public health concern or event, such as the discovery of contamination in a community, or an unusual occurrence of a disease. Investigations follow a scientific process, may be hypothesis-driven, and have an end date, when data collection, analysis and conclusions are complete. As such, they can be easily distinguished from ongoing tracking (surveillance) activities which are planned to take place over time. Special investigations are common in public health practice. They can be distinguished from research activities by the fact that the results are intended to describe only the population under investigation; they are not intended to add to broader scientific knowledge.

This approach was used in the state's pilot program. In this context, biomonitoring studies identify the range and distribution of

exposures in the selected communities and in subgroups of the community. Studies could identify individuals or groups who are most highly exposed in the community who might need additional medical follow-up or counseling. Combined with a thorough exposure assessment and/or adequate follow-up investigation, special investigations can help to identify the exposure pathways that led to high chemical concentrations. Community measurements could be compared to statewide measurements, if available, or to national measurements obtained by the CDC to determine whether community measurements are the same as or different from those of the general population. The approach, if implemented, could be used to identify the need for, or to evaluate, prior community public health action.

Strengths of a special investigations approach

Special investigations that are well designed, timely and responsive to community concerns can provide benefits to the community under

investigation. They have the potential to provide valuable information about whether community members have been exposed to an environmental contaminant in order to plan an appropriate public health response. Such projects can identify individuals or subgroups whose exposures are elevated above the community or national norm. They can also lead to additional investigation, community health education or other positive public health actions. With appropriate planning and follow-up, they provide a way to measure whether community remediation efforts were effective.

Challenges of a special investigations approach

While special investigations can be a useful tool for responding to community concerns about chemical exposures, significant challenges and limitations of conducting biomonitoring in this context have been identified through the pilot program.

First, significant time and resources are needed to adequately plan and implement a community-based study. A minimum of one year of planning is needed to develop a high quality study design, obtain appropriate approvals, and develop laboratory methods. Unless there is strong community involvement, the difficulty of recruitment in neighborhoods, particularly where there may be cultural or communication barriers, is significant. Ample time for engagement is crucial to establishing community relationships

and to learn how to communicate appropriately within each community. The time delays may not be acceptable to community members and local officials, who understandably wish for action as soon as possible.

Biomonitoring may not be the appropriate response to many contamination incidents, particularly for chemicals that are quickly eliminated from the body or when remediation efforts have already removed the exposure source. Measuring the exposure after an intervention has been implemented is likely to miss the highest exposures that occurred in the past. Other investigative tools are used by agency staff to assess community exposures and health risks in these cases.

If MDH were to implement an ongoing program using this approach, proposed investigations must be reviewed and prioritized, and costs weighed against available resources and competing priorities. Per Minnesota Statutes 144.998, subdivision 3, paragraphs (1) to (7), the EHTB Advisory Panel has a clear role in developing priorities for biomonitoring populations and chemicals and then recommending them to the MDH commissioner. Local public health agency officials are often helpful in representing the concerns of their communities and should be consulted before decisions about conducting special investigations of community health concerns.

Special Investigations Example: Perfluorochemicals (PFCs) in the East Metro

The East Metro PFC Biomonitoring Project, one of the biomonitoring pilot projects, took place in a community identified as likely to be exposed. The project measured seven PFCs in the blood of 196 residents, age 20-86, living in a community with known PFC contamination in drinking water. Three of the chemicals were detected in all participants. Average exposures to two chemicals (PFOA and PFOS) were 2-4 times higher than the average levels found in the general US population, but lower than levels found in other contaminated communities and in occupational groups. Exposures for three chemicals increased with age and were higher in men.

No health- or clinic-based values exist for interpreting PFC levels in blood and no medical follow-up was recommended for participants. The EHTB Advisory Panel recommended a follow-up study, which will be conducted in 2010-2011, to determine whether PFC levels are decreasing in the population over time due to remediation efforts implemented since 2005 that have removed PFCs from the drinking water.

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Recommendations for an Ongoing Biomonitoring Program

Given the strengths and limitations of each of the approaches, MDH staff and the EHTB Advisory Panel support and recommend the following two-tiered approach for an ongoing biomonitoring program at MDH:

Tier 1. Continued planning for an ongoing biomonitoring program focused on targeted population exposure tracking.

Given current fiscal challenges in the state budget, costly implementation of the full model to include the statewide exposure tracking approach must be weighed against more immediate priorities. The targeted approach is less costly and can best be aligned with agency priorities and programs. It can be integrated with Environmental Public Health Tracking data, and has the greatest promise for advancing both the science and practice of biomonitoring in public health. This approach best maintains and strengthens state capacity for the future and can be expanded as resources allow. Continued strategic planning for a targeted approach is recommended and should include efforts to seek broader stakeholder input for selecting a targeted population and priority chemicals that are in line with agency priorities for addressing children's health and health disparities in the population.

Tier 2. Coordinated pursuit of external funding for special community-based investigations conducted in collaboration with the state biomonitoring program.

External collaborations with researchers in other programs, agencies, or the University of Minnesota offer opportunities to build the science and practice of biomonitoring through special investigations and are complimentary to the goals of a sustained program. Such collaborative investigations will help the state in addressing special needs of local communities where appropriate, while leveraging resources wisely. Likely sources of such external funding include several CDC programs as well as research programs. In 2010, MDH successfully obtained external funding from the CDC to

conduct a 3-year biomonitoring investigation of exposures in a tribal community, largely because of Minnesota's demonstrated capacity to conduct biomonitoring investigations.

Both strategies – targeted population exposure tracking and special investigations in communities – serve important public health functions that not only fall within MDH's purpose, but are fiscally responsible. Maintaining a base program that tracks exposure in targeted populations will position MDH well to be successful in competitive applications for additional funding and will speed the department's ability to respond to community concerns and emerging health threats. With this two-tiered approach, MDH will have the best chance at successfully achieving the vision and goal of healthy Minnesotans living in safe environments.

Biomonitoring in Minnesota: looking ahead

With four pilot projects completed or nearing completion, Minnesota has built the knowledge, skills and relationships necessary for implementing an ongoing state biomonitoring program. Limited resources require MDH to focus next on prioritizing and recommending specific target populations and target chemicals to be included in future biomonitoring efforts. Planning efforts will also identify available resources, partnerships and funding sources for maintaining the capacity that has been created so that MDH will be prepared to respond to the future needs of Minnesota communities.

MDH will continue to communicate the successes and lessons learned from the pilot biomonitoring program, and will continue to develop and implement "best practices" guidance for ensuring that the program meets public health goals and uses its resources wisely. Methods for improving results communications and community engagement will be explored further, and the advisory panel will be engaged in dialogue on the effect of informed consent on

data collection for improving public health practice and protection.

This unique program has positioned Minnesota well among the leading states in the country for improving our understanding and skills for applying this valuable tool to environmental public health practice.

THE ENVIRONMENTAL HEALTH TRACKING AND BIOMONITORING ADVISORY PANEL

The Environmental Health Tracking and Biomonitoring (EHTB) Advisory Panel advises program staff in the planning and implementation of the biomonitoring and environmental health tracking programs. As required by statute, the panel comprises scientists and citizens who have experience or training in designing, implementing, and interpreting health tracking and biomonitoring studies or in related fields of science. The panel members represent industry, medicine, public health, non-governmental organizations, academia, and state agencies. The panel allows program staff to hear many viewpoints and to benefit from a wide range of expertise.

Panel members serve as volunteers and meet regularly, four times per year. Occasionally, an additional meeting is scheduled to tackle a specific topic that cannot be adequately addressed during the limited time available for regular panel meetings. In 2008, for example, panel members were invited to attend extra meetings to inform the development of a strategic plan for the biomonitoring program.

The role defined for the EHTB advisory panel in statute is broad. The panel is given responsibility for consulting with MDH on virtually all aspects of program development and implementation. The panel's purview extends to issues both large and small, including those related to the scientific integrity of program activities and overall priority setting as well as those related to specific program functions, such as training and communications.

During 2009 and 2010, the advisory panel was instrumental in advising the program in many areas including the following:

- Reviewed analytical results of the East Metro PFC Biomonitoring Project and advised on interpretation and methods.
- Based on the findings of the East Metro PFC project, recommended a follow-up study to measure changes in PFC serum levels over a two-year time period in the same group of people. The panel was consulted on study purpose, design and data collection. This follow-up project is now in progress.
- Engaged with staff in strategic planning for developing recommendations for ongoing biomonitoring program.
- Reviewed analytical results of the Minneapolis Children's Arsenic Study, biomonitoring pilot project, and advised staff on interpretation and communication of the findings.
- Provided input on lessons learned from pilot projects, and the strengths and limitations of various strategies and approaches for biomonitoring.
- Advised on priorities and criteria for developing new data and measures for tracking exposure to health hazards in Minnesota, including environmental tobacco smoke, pesticides and radon.
- Advised staff on collaborations with academic partners.
- Reviewed available data for tracking the public health impacts of climate change.

All meetings of the panel are open to the public. Meeting dates and materials are posted on the MDH website at:
<http://www.health.state.mn.us/tracking/>

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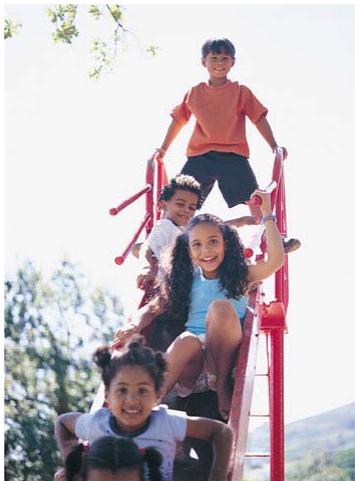
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Appendix A: Pilot project community report for the Minneapolis Children's arsenic study



Minneapolis Children's Arsenic Study A Biomonitoring Pilot Project Report to the Community April 2009

What is the Minneapolis Children's Arsenic Study?

This study is a biomonitoring pilot project. It was done to measure how much arsenic children in the community are coming into contact with. Biomonitoring measures how much arsenic has gotten inside a person's body by taking a sample from the body. We wanted to see what the average level of arsenic was, and how much the levels varied across everyone who is tested as part of the study. We wanted to know whether levels in the community are different from levels found in other communities. We wanted to know whether children living at homes with higher soil arsenic also have higher arsenic levels in their bodies.

Because this is a small pilot study and not a health study, this project was not planned to provide information on the health effects of being exposed to arsenic. It also was not designed to find out all of the places where children might be exposed. This pilot study will help the state learn more about how to do biomonitoring in the future in ways that will help answer important questions about chemicals and public health.

Why was this pilot project done with children in South Minneapolis?

Yards in a portion of south Minneapolis, including the Phillips neighborhood, have been tested and found to contain higher than normal levels of arsenic in the soil. Testing of the yards began in 2001, after state officials discovered arsenic contamination on the site of a former pesticide storage facility. Between 2001 and 2006 about 4000 properties were tested. Residents living in the area are concerned that their children may have been exposed to arsenic in the soil in their yards.

Young children are more likely than adults to be exposed to arsenic in soil because they spend time playing outside in the soil and are more likely to get dirt in their mouths, especially in the summer. There are many other possible sources of arsenic, including CCA-treated wood playsets, pesticides and fertilizers, traditional medicines or supplements and foods such as seafood and rice. Usually the arsenic in food is not as harmful as arsenic from other sources. It is difficult to know about long term exposures to arsenic because arsenic does not stay in the body for very long.

How did the pilot project work?

The Minneapolis community selected for this project includes all of the neighborhoods of East Phillips, parts of Ventura Village and Midtown Phillips, as well as parts of Powderhorn, Corcoran, Longfellow and Seward. We began outreach and education with community members in December 2007 through public meetings, newspaper articles, neighborhood organizations, clinics and local government committees. Ideas and comments from these discussions were included in the design of the project.



The plan was to invite 100 children between the ages of 3 and 10 years. The first children invited to participate lived in homes where testing found the arsenic level in the soil in the yard to be more than 20 parts per million and the yard had not yet been cleaned up. All of the homes received information about the study in the mail or from home visits by study staff. Of the 833 homes that were eligible, 105 had children between the ages of 3 and 10. Out of the 105 families with children, 40 children chose to participate.

To include more children, the project staff opened up eligibility to any home that had the soil tested by US EPA, a total of 2,652 homes. In response, an additional 25 children were enrolled for a total of 65 children. All families who agreed to participate filled out a short questionnaire and each child gave a small amount of urine on two mornings in a row with their parent's help and consent.

How was the arsenic level measured?



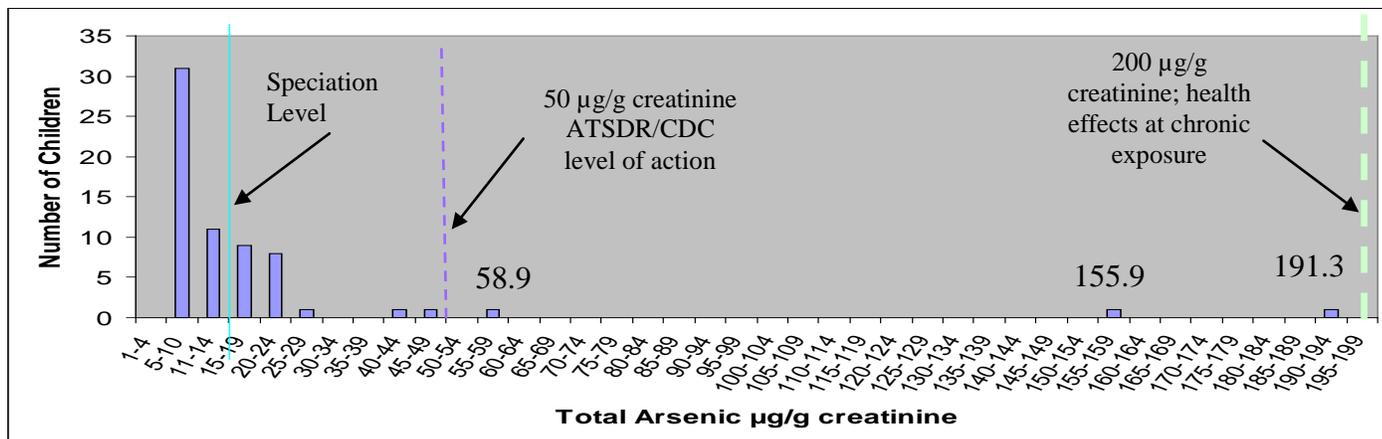
The MDH Public Health Laboratory tested the urine samples to measure the total amount of arsenic found in the urine. If the total amount of arsenic found in the children's urine reached a certain level (15 ug/g creatinine*) another test, called "speciation" was done to see how much of the arsenic was organic, a less toxic form of arsenic that comes from food, and how much is the more toxic inorganic form of arsenic.

Footnote * micrograms per gram of creatinine –A microgram is 1 millionth of a gram. Creatinine is a natural substance in urine that can tell us how concentrated (weak or strong) the urine is.

What are the results of the pilot project?

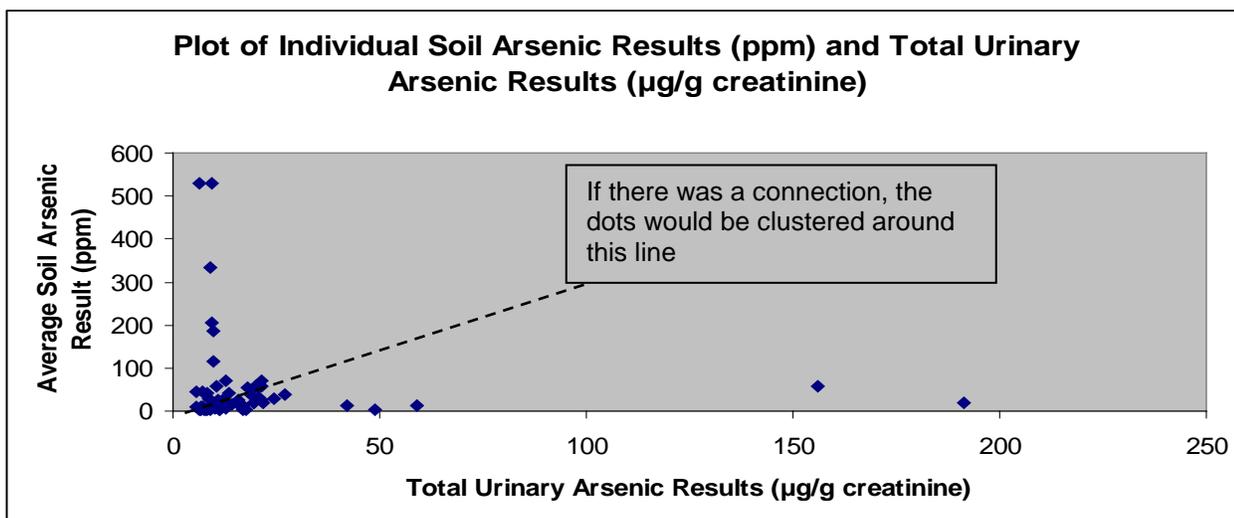
Test results and educational information were mailed to each of the families participating in the study. Most of the children had levels of arsenic well below where there would be concern for the children's health. Four children's results were near or higher than the action level that indicates that the children are coming into contact with arsenic. These families were given help for follow up with a physician. While we know their results were high, these children did not live in homes with the highest levels of arsenic in the soil.

The results from the 65 children are displayed in the graph below.



Is there a connection between arsenic in soil and the level of arsenic found in their urine?

We can look at the level of arsenic in the children's yards and the level of arsenic in their urine together to see if there might be a connection. In the graph below, the left hand vertical line shows the level of arsenic in the children's yards. The horizontal line across the bottom shows the level of arsenic in the children's urine. We found no relationship between the levels in the soil and levels in the urine.



What did we learn from the pilot project?

The results tell us that the arsenic found in most children in the community was below a level of concern and that a few children, who did have higher levels of arsenic in their urine, are probably getting the arsenic from other sources and not from the soil. Even so, parents are reminded that soils can contain small amounts of toxic substances such as arsenic and lead. Parents should be careful to prevent children from getting dirt in their mouths, and should help their children to avoid all sources of arsenic exposure.

The results from this project are very similar to other community studies with children. This tells us that, overall, children's exposures in this community are not unusual for children living in a city.

For future biomonitoring projects, we learned how important it is for people living in the community to be involved. Researchers and the community must work together to ensure broad participation and results that are meaningful to the community. We will look to the community for input and ideas about any further action that should be taken to prevent children from coming into contact with arsenic.

Where can I get more information?

The study was done by the Minnesota Department of Health. In 2007, the Minnesota Legislature passed a new law creating the Environmental Public Health Tracking and Biomonitoring Program at the Minnesota Department of Health. The program is conducting 4 pilot biomonitoring pilot project in communities that are likely to be exposed to chemicals in the environment.

For more information about this study, or about this pilot biomonitoring program, please contact the Minnesota Department of Health, Environmental Public Health Tracking and Biomonitoring Program, at 651-201-3661 or visit our website at:
<http://www.health.state.mn.us/tracking>

For information about sources of arsenic exposure and ways to avoid arsenic, please visit the website at:
<http://www.health.state.mn.us/divs/eh/hazardous/topics/arsenic.html>



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APRIL 2009

APPENDIX B : PILOT PROJECT COMMUNITY REPORT FOR THE EAST METRO PERFLUORO-CHEMICAL BIOMONITORING PROJECT



East Metro Perfluorochemical Biomonitoring Pilot Project Report to the Community

July 2009

What is the East Metro Perfluorochemical Biomonitoring Project?

This study is a biomonitoring pilot project. Biomonitoring means directly measuring the amount of a chemical in someone's body. This study was done to measure perfluorochemicals (PFCs) in the blood of people who had PFCs in their drinking water. We want to see what the average levels of PFCs are, and how much the levels vary across everyone who was tested as part of the study. We want to know whether levels in the groups we studied are different from levels found in other studies.

Because this is a small pilot study and not a health study, this project was not designed to provide information on the health effects of being exposed to PFCs. It also was not designed to find out all of the ways that people might be exposed to PFCs. This pilot study will help the Minnesota Department of Health (MDH) learn more about how to do biomonitoring in the future.

Why was this pilot project done in the East Metro?

Residents in communities located east of the Minneapolis-St. Paul metropolitan area of Minnesota (East Metro) are concerned about exposure to perfluorochemicals in drinking water. Disposal of PFC-containing wastes in the past led to PFCs moving into the groundwater in these communities. In 2007 the Minnesota Legislature directed MDH to conduct a pilot biomonitoring project to measure perfluorochemicals in two communities that were exposed to PFCs in drinking water.

What are perfluorochemicals?

Perfluorochemicals (PFCs) are a family of manmade chemicals that have been used for decades to make products that resist heat, oil, stains, grease and water. Common uses include nonstick cookware, stain-resistant carpets and fabrics, as components of fire-fighting foam, and other industrial applications.

How were people chosen for the study?

Scientists at MDH chose two communities in the East Metro area based on their past exposure to PFCs in drinking water:

- 100 residents of Oakdale who get their drinking water from city wells; and,
- 100 residents of Lake Elmo and Cottage Grove who got their drinking water from a private well that had at least 0.1 parts per billion (ppb) of either PFOA or PFOS in the water.

Participants had to be age 20 or older and have lived in their current home since January 1, 2005.

For Oakdale, 500 households were randomly selected from the city utility billing records and asked to complete a survey. For the Lake Elmo/Cottage Grove group, all households that had used a private well with the minimum levels of PFCs were contacted and asked to complete a survey. From each group, 100 people were randomly chosen and invited to participate.

How did the pilot project work?

Each person who agreed to participate was asked to sign and return a consent form. They were then asked to go to a local clinic and give a small amount of blood. They also answered a series of questions in a telephone interview. Ninety-eight people from each group completed all of these steps, for a total of 196 people in the study. There were 88 men and 108 women, who participated. They ranged in age from 20-86 years, with an average age of 53. Most had lived in their homes for over 10 years; the average was 18 years.

How were the PFCs measured?

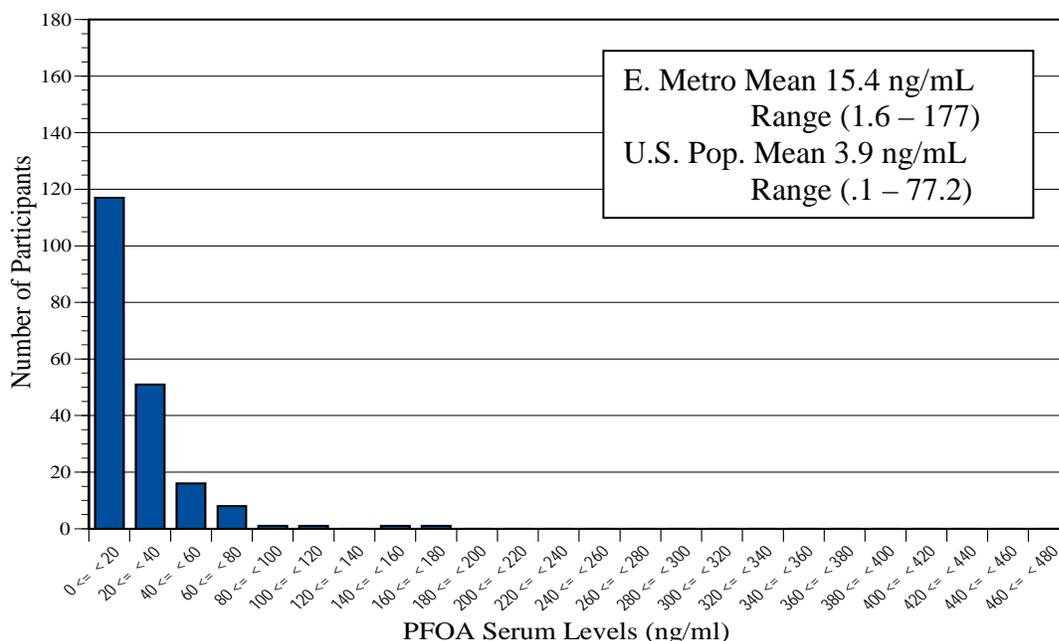
The blood samples were taken from the clinic to the MDH Public Health Laboratory and analyzed to measure the amount seven PFC chemicals:

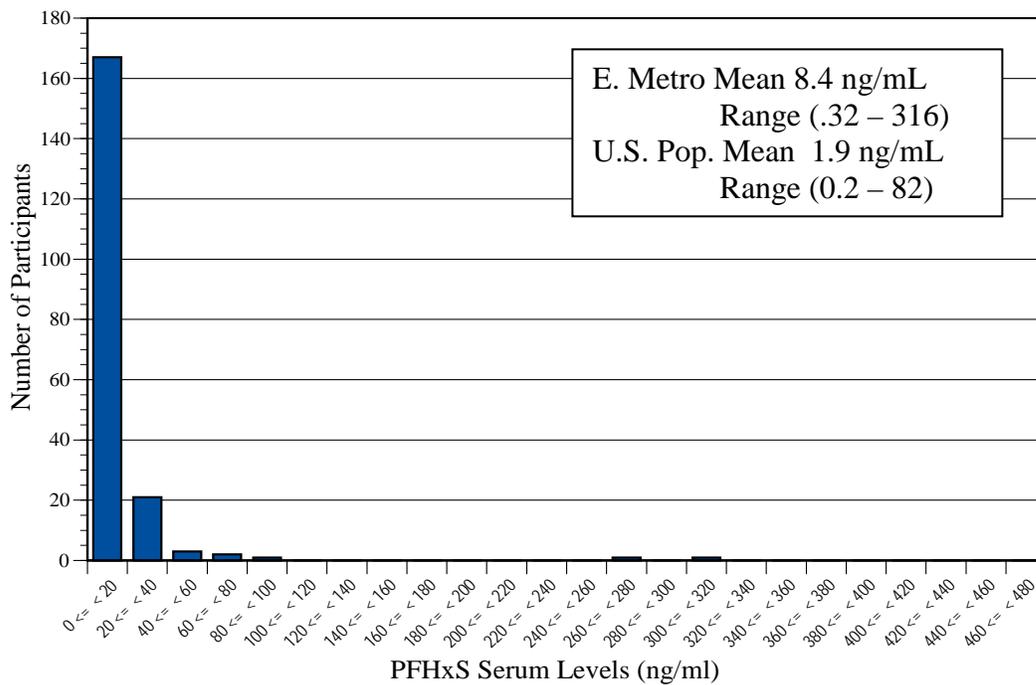
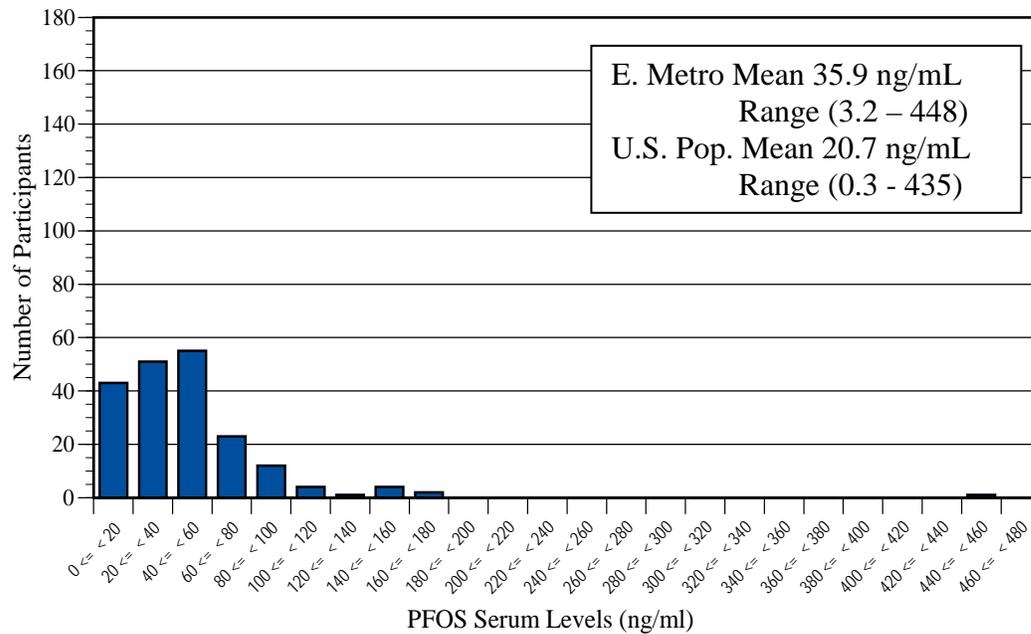
- perfluorooctanoic acid (PFOA)
- perfluorooctane sulfonate (PFOS)
- perfluorobutanoic acid (PFBA)
- perfluorobutane sulfonate (PFBS)
- perfluorohexane sulfonate (PFHxS)
- perfluorohexanoic acid (PFHxA)
- perfluoropentanoic acid (PFPeA)

What are the results of the pilot project?

Three chemicals, PFOA, PFOS and PFHxS, were found in the blood of every person in the study. PFBA was found in blood from 55 of the 196 people (28%). PFBS was found in blood from five people. PFPeA and PFHxA were not found in any blood samples.

The graphs below show how much PFOA, PFOS, and PFHxS were found for all participants in the project. They also show how the average and range (low to high) compare with levels found in the US population.





Each PFC chemical stays in people’s bodies for a different length of time. The amount of time it takes for our bodies to get rid of half of the amount of PFOA in our bodies is about 4 years; for PFBA it only takes several days. So, the amount of a PFC found in people’s blood is affected by how much they take in and by how long it takes for the human body to get rid of it. The amount of each PFC in drinking water varies throughout the East Metro. PFBA is the most widespread. Some of the PFCs measured in the study are being phased out of most commercial uses. Others, like PFBS, are thought to be less toxic and are now being used more widely.

Studies of the general population tell us that most people in the US have small amounts of PFCs in their blood. MDH compared the average (or geometric mean) amount of PFCs found in the study communities to the average amount found in a sample of the US population. We found that the average levels of PFCs in both groups of people tested in this project were somewhat higher than the general US population.

PFC levels in blood were a little higher in men, and levels increased with age. The amount of some PFCs seems to increase the longer a person lived in a home with PFCs in the drinking water. The average amounts of PFCs found in people drinking Oakdale city water were not different from people drinking private well water in Lake Elmo or Cottage Grove.

How do these results compare with other community studies?

There are two other reports of communities that were exposed to PFCs through drinking water. In the Ohio River Valley, residents of the Little Hocking Water District drank water with much higher levels of PFOA than the East Metro residents. Their blood sample results are also much higher than the East Metro results. The second group in Arnsberg, Germany drank water with levels of PFOA that are similar to the East Metro levels and their blood results are also similar.

Blood test results found in studies of 3M employees who were exposed through their work with PFCs had results much higher than any of the community studies.

What did we learn and what will happen next?

This pilot project helped MDH learn ways to work with communities to conduct biomonitoring and for measuring PFCs in human blood. The lessons learned will be helpful for possible future investigations of the ways people are exposed to PFCs and ways to prevent exposures. Community members are invited to give input on what will happen next.

Studies have found that levels of PFCs in the US general population are decreasing. An advisory panel for this project has recommended to MDH that there be another study in these communities in the future to see whether exposure levels are changing over time. Actions taken since the PFCs were found in the groundwater have reduced people's exposure from drinking water. We expect that the levels of PFCs in people's bodies will decrease over time to levels that are similar to those found in the general population.

Where can I get more information?

For more information about this study or about this pilot biomonitoring program, or if you wish to obtain a copy of the complete technical report, please contact the Minnesota Department of Health, Environmental Public Health Tracking and Biomonitoring Program, at 651-201-5902 or visit our website at:

<http://www.health.state.mn.us/tracking> .

For information about PFCs, please visit MDH's Web site at:

<http://www.health.state.mn.us/divs/eh/hazardous/topics/pfcs/index.html> .