Minnesota Department of Health Environmental Health Tracking and Biomonitoring Advisory Panel Meeting

FEBRUARY 11, 2020

1:00 P.M. – 4:00 P.M.

Wilder Foundation

451 Lexington Parkway North

St. Paul, Minnesota

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Agenda Overview

DATE: 02/11/2020

Welcome & Introductions

1:00pm

Ruby Nguyen (substituting for chair Lisa Yost) will welcome attendees to the panel meeting. Panel members and audience are invited to introduce themselves.

Agenda Overview

1:05pm

Jessica Nelson (substituting for Jessie Shmool) will give a brief overview of topics and discussion items.

Overview of CDC's State Biomonitoring Program

1:10pm

Project Officer Kristin Dortch of the Centers for Disease Control and Prevention (CDC) will discuss the national network of state biomonitoring programs, which now includes Minnesota. Panel members are invited to ask questions and provide comments.

NHANES Biomonitoring Methods for Assessing Exposure to Plasticizers and Flame Retardants

1:20pm

CDC subject matter expert Dr. Antonia Calafat will present on research methods employed in the National Health and Nutrition Examination Survey (NHANES). Panel members are invited to ask questions and provide comments.

Draft Protocol for CDC Biomonitoring Grant

2:05pm

Jessica Nelson will present a draft protocol for the statewide Biomonitoring program expansion.

2:25pm Discussion

Questions for the Panel

- Are there other survey, demographic or complementary environmental data we should incorporate?

- For private well testing offered as a benefit to participants, how important is it for MDH to get individual-level water data (to link to biomonitoring results)?
- Would you suggest any modifications to the results return protocol?

Refreshments

2:45pm

Inorganic Mercury Screening in Pregnancy to Reduce Harmful Exposures: A Quality Improvement Project

3:00pm

Doctoral nursing student Andrea Jordan will present on clinic screenings for urine mercury. Michael Xiong of the Minnesota Pollution Control Agency (MPCA) will recount his experiences conducting home visits for women with elevated urine mercury levels. Panel members are invited to ask questions and provide comments.

3:20pm Discussion

Questions for the Panel

- As we plan to expand clinical screening efforts, what opportunities or barriers should we consider?
- How best can we assess the effectiveness of this work, and to whom should we communicate the results?

Healthy Rural and Urban Kids Updates

3:35pm

Jessica Nelson will give a brief update on the 2018 Healthy Rural and Urban Kids study. Panel members are invited to ask questions and provide comments.

Public Comments & Audience Questions

3:45pm

New Business

3:55pm

Motion to Adjourn

4:00pm

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Overview of CDC's State Biomonitoring Program

Project Officer Kristin Dortch of the Centers for Disease Control and Prevention (CDC) will discuss the national network of state biomonitoring programs, which now includes Minnesota. Panel members are invited to ask questions and provide comments.

Kristin Dortch provides leadership and coordination of CDC's State-Based Public Health Laboratory Biomonitoring Program. She is Health Scientist on the policy team in the National Center for Environmental Health's, Division of Laboratory Sciences located in Atlanta, GA.

Kristin earned her Bachelor of Science degree in Chemical Engineering Technology from Savannah State University and her Master of Science in Chemistry from Georgia State University. She came to CDC as an Oak Ridge Institute for Science and Education Fellow in 2010 as a research scientist in the Organic Analytical Toxicology Branch and the Tobacco Volatiles Branch and joined the Office of the Director in 2016.

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NHANES Biomonitoring Methods for Assessing Exposure to Plasticizers and Flame Retardants

CDC subject matter expert Dr. Antonia Calafat will present on research methods employed in the National Health and Nutrition Examination Survey (NHANES) with a focus on urine measurements of phthalates and organophosphate flame retardants. The Public Health Laboratory at MDH is currently developing capacity for these two new classes of chemicals as part of the statewide CDC grant (for more information, see Protocol, below). Panel members are invited to ask questions and provide comments.

Dr. Antonia Calafat is the Chief of the Organic Analytical Toxicology Branch, Division of Laboratory Sciences, National Center for Environmental Health, U.S. Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. She leads CDC's biomonitoring programs for assessing human exposure to per- and polyfluoroalkyl substances (PFAS); polybrominated diphenyl ethers; polychlorinated dibenzo-p-dioxins, furans, and biphenyls; pesticides; flame retardants; polycyclic aromatic hydrocarbons; and chemicals added to consumer and personal-care products such as phthalates and phenols.

Dr. Calafat has developed and maintained extensive collaborative research with leading scientists in the fields of exposure science, epidemiology, toxicology, and health assessment. Her research has made important contributions to biomonitoring science, including CDC's National Reports on Human Exposure to Environmental Chemicals. She received the 2019 Excellence in Exposure Science Award granted by the International Society of Exposure Science in recognition of her scientific contributions, service, and leadership to the field.

Dr. Calafat earned her PhD in Chemistry in 1989 from the University of the Balearic Islands, Spain. She was a Fulbright Scholar at the Department of Chemistry of Emory University where she completed her postdoctoral training. She joined CDC in 1996.

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Draft Protocol for CDC Biomonitoring Grant

Jessica Nelson will present a draft protocol for the statewide Biomonitoring program expansion.

Introduction

This protocol describes a statewide, ongoing biomonitoring program that will measure chemical exposures in children from communities across Minnesota. The program will focus on exposure disparities and health disparities.

An MDH strategic planning process in 2013 identified children as a key target population for biomonitoring (MDH 2013). Scientific research continues to demonstrate the importance of early childhood exposures for lifelong health. Children are uniquely vulnerable to environmental exposures as in utero and early-life exposure to chemicals can harm the developing brain and body systems (Selevan 2000). Our strategic planning process also identified disadvantaged populations and rural communities as an important focus.

Minnesota's child population – roughly 420,000 children under age six – is becoming more racially and ethnically diverse (MDH 2014). Children of color and American Indians make up about 30% of children under age six. The youngest Minnesotans are also the poorest, with one in five children living in poverty (MDH 2014).

These socio-economic disparities have important environmental health implications. In urban populations, communities with lower incomes and higher proportions of people of color may be more highly exposed to environmental chemicals in air pollution and personal care products, and from inadequate housing (Gracia 2011, Zota 2017). Children in rural areas may be disproportionately exposed to environmental chemicals including pesticides and metals as a result of drinking water, agricultural drift, and other exposure sources.

The following protocol builds upon the population-based recruitment model developed in our IRB-approved Healthy Rural and Urban Kids project (Healthy Kids 2018). Using this model, the program will partner with Early Childhood Screening (ECS) programs in local public health agencies and school districts to use systematic sampling techniques to recruit and collect urine samples from 3-6 year-old children.

We propose to:

- Sample children from one of five Metro-area regions and one of five non-Metro regions per year, aiming to recruit 250-300 children per region per year.
- Move recruitment systematically through the regions of the state.
- Analyze urine samples for a suite of analytes of concern based on the state's geology, industries, and population, and that are tied to state policy initiatives.
- Provide appropriate public health follow up to families of children whose results exceed thresholds.
- Communicate results to all families in an informative and constructive manner.
- Share results widely with communities and other important stakeholder groups.

Program goals

1. Establish a statewide biomonitoring surveillance program to systematically measure chemical exposures in children with a focus on chemicals of concern for child development.
2. Measure and compare the extent of chemical exposures in Minnesota children from Metro and non-Metro communities for each 1-year cycle.
3. Assess whether some children are more highly exposed to certain chemicals than others by investigating disparities by sociodemographic variables.
4. Compare results to national and state biomonitoring data and to Healthy People 2020 goals.
5. Investigate sources of exposure using survey and GIS data.
6. Calculate statewide estimates using statistical weighting methods at the end of the full five years of sampling.
7. Collect data on multiple time points per region, enabling long-term time trend analysis by region and by the state as a whole.
8. Expand children's environmental health outreach and education and build partnerships with key stakeholders in different areas of the state.
9. Assess whether targeted public health actions are needed to reduce exposures and protect child health in these communities.

Program design

Population-based recruitment approach

To achieve a representative sample of preschool-aged (3-6 year-old) Minnesota children, we will use population-based recruitment methods in partnership with ECS programs. Our sampling frame will be children who come in for their ECS visits during the 6-month recruitment period. This model was extremely successful in our recent Healthy Kids 2018 project.

ECS is a universal program in Minnesota; by state law, all children must be screened before entering kindergarten. The process differs across school districts. In some cases, the school district performs the screening directly. In other cases, the school district contracts the work to a local public health agency.

At the screening visit, trained staff screen children for vision and hearing problems, collect health history, and assess growth and development. Families have the opportunity to learn about programs available to help their child get ready for kindergarten. Depending on the screening results, they may be referred directly for services. Screening is recommended at age 3 so children can access needed services before entering kindergarten, but it can continue through a 30-day window after a child enters kindergarten.

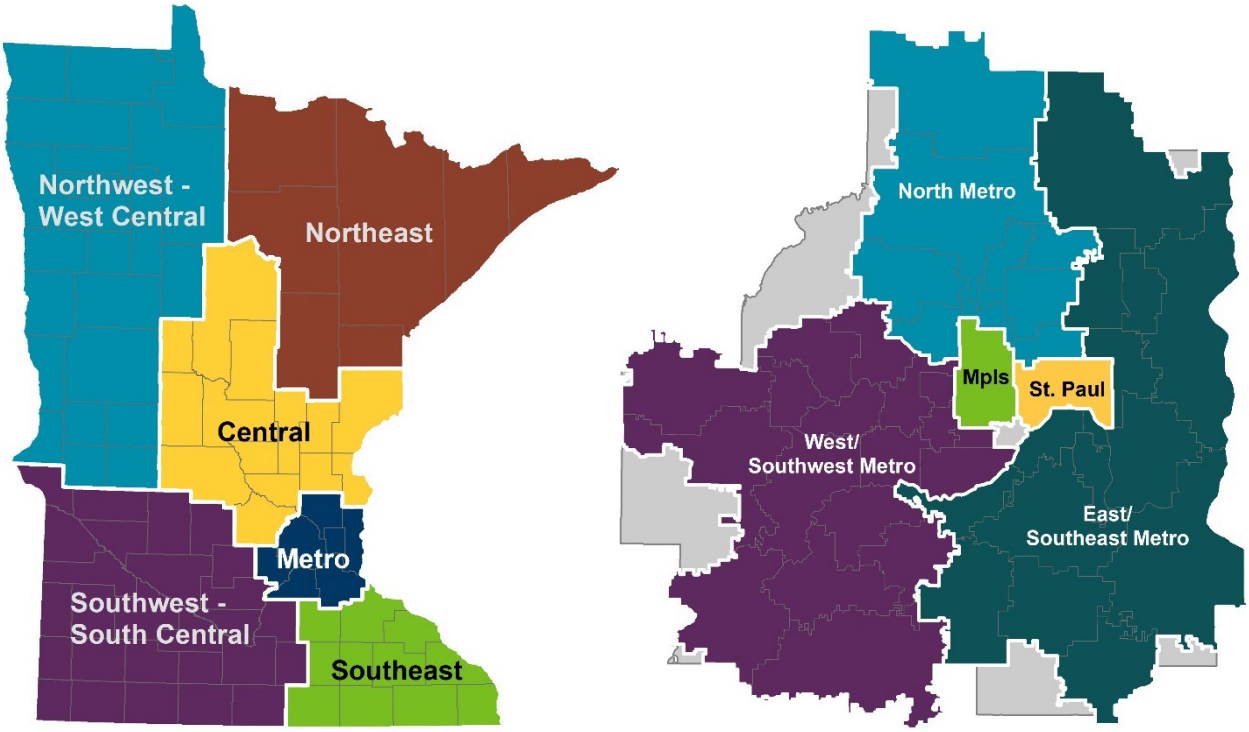
Our recruitment goal will be 250-300 children per year from each region (non-Metro and Metro), for a total of 500-600 children per year. The period of recruitment will be a six-month window between May and October, when outdoor exposures tend to increase and the greatest

proportion of ECS screenings occur. Recruitment partners will have a target number of children to recruit each month to ensure that recruitment is spread throughout the 6-month period.

Statewide sampling design

We will divide the state into a) five non-Metro regions using the State Community Health Services Advisory Committee (SCHSAC) regions as a framework, and b) five Metro regions using school district boundaries (see Figure 1). We will recruit children from one non-Metro region and one Metro region each year. We will sample a sub-set of counties/school districts in each region to be representative of the entire region and move recruitment systematically through these regions. The first cycle, referred to as "Healthy Kids Minnesota 2020,"will begin with southeast Minnesota and Minneapolis.

Figure 1. Non-metro and Metro regions



Non-Metro regions

We will use a three-tiered approach to sample non-Metro regions:

1. Large population centers (population > 40,000): Sample these with certainty.
2. Mid-size population centers (population 15,000-40,000): Sample 1-2 of these.
3. Rural parts of counties whose local public health agency administers ECS programs: Sample two of these.

To select the specific mid-size population centers and county public health agencies with whom to partner, we will reach out to local public health and school districts in the region to learn more about how ECS works in their area and gauge interest in partnering. We will determine which sites to select for recruitment based on the following factors, using random sampling when possible:

- Geographic coverage of the region
- Area demographics compared to the overall region in terms of U.S. Census data on race/ethnicity, English spoken at home, education, and income
- Interest by local agency/school district
- Potential to advance health equity goals

We will establish recruitment goals for each site proportional to population.

Metro regions

For the program cycles that include Minneapolis (2020) and St. Paul, there is only one school district in the region. In this case, we will partner with the school district as the recruitment site. To ensure robust sample size during analysis, we will use stratified sampling for two primary variables of interest: geographic coverage of the school district (i.e. North Minneapolis and South Minneapolis) and race/ethnicity. We will develop target recruitment numbers for each month for these two factors.

For the program cycles that include Metro regions made up of more than one school district, we will select 2-3 school districts with whom to partner. As in the non-Metro regions, we will determine which sites to select for recruitment based on the following factors, using random sampling when possible:

- Geographic coverage of the region
- District demographics compared to the overall region in terms of U.S. Census data on race/ethnicity, English spoken at home, education, and income
- Interest by school district
- Potential to advance health equity goals

We will establish recruitment goals for each site proportional to population.

Tribal areas

When the region sampled includes any of Minnesota's 11 Tribal Nations, we will work with the Tribes using existing MDH-Tribal relationships to explore Tribal participation and how best to sample the preschool-age population.

Biomarker selection

Metals

This program will measure twelve urine metals (see Table 1). Groundwater in many areas of Minnesota contains high levels of naturally-occurring metals, including arsenic and manganese. Approximately 95% of rural Minnesota households use private wells for drinking water. Water testing has found that around 50% of private wells tested for manganese and around 10% tested for arsenic exceed MDH water standards (MDH 2012, 2019a). Exposure to metals may also occur through diet and air pollution. A recent MDH study found disparities in exposure to urine mercury related to using skin lightening products (MDH 2019b). Possible health impacts from the proposed group of metals vary, ranging from neurodevelopment to skin sensitivity/allergy; exposure to some of the metals, notably arsenic, manganese, and chromium, is of greater concern for children's health. This is an expanded list compared to the five metals measured in Healthy Kids 2018.

Table 1. Metal biomarkers in urine

Chemical	Main sources
Arsenic (including speciation)	Drinking water, diet, industrial emissions
Cadmium	Diet, cigarette smoke, children's jewelry, occupational (welding), industry
Chromium	Diet, waste sites, industrial emissions, occupational
Cobalt	Industrial emissions, diet
Manganese	Drinking water, industrial emissions, diet
Mercury	Personal care products containing mercury, broken thermometers
Molybdenum	Diet, flame retardant, paint/ceramics, occupational
Nickel	Industrial emissions, diet, drinking water
Antimony	Diet, flame retardants, occupational
Thallium	Coal-burning and smelting processes, industrial emissions, ore processing
Tungsten	Drinking water, occupational
Uranium	Drinking water, diet, occupational

Note on sources: In addition to the specific sources cited for information on these and other biomarkers in this section, the "Biomonitoring summaries" by the CDC National Biomonitoring Program were also used.

Pesticides

This program will measure urine concentrations of three types of pesticides: organophosphates, pyrethroids, and 2,4-D (see Table 2). Minnesota is a highly agricultural state, ranking in the top five in the U.S. for production of corn, soybeans, and sugarbeets (NASS 2018). Sandy soils in certain parts of the state make groundwater vulnerable to contamination, and pesticides are commonly found in water. The herbicide 2,4-D is found in 100% of rainfall samples (MDA 2018). The organophosphate chlorpyrifos has been detected with increasing

frequency in surface water, at times at elevated levels (MDA 2018). Some rural communities may be exposed to agricultural pesticides through drift and drinking water. Rural residents may also be exposed to pesticides used in the home and on lawns. There are also environmental justice concerns about disparities in urban exposures due to poor housing conditions and use of pesticides for pest control (Landrigan 1999, Julien 2008). Health concerns due to pesticide exposure range from cancer to developmental and neurotoxic effects. This list does not include two additional pesticides measured in Healthy Kids 2018 (mancozeb and carbaryl).

Table 2. Pesticide biomarkers

Chemical	Parent compound
3,5,6-trichloro-2-pyridinol (TCPY)	Chlorpyrifos, chlorpyrifos methyl
4-nitrophenol (PNP, 4-PNP)	Parathion, methyl parathion
Malathion dicarboxylic acid (MDA)	Malathion
2-isopropyl-4-methyl-6-hydroxypyrimidine (IMPY)	Diazinon
2,4-dichlorophenoxy acetic acid (2,4-D)	2,4-D
3-Phenoxybenzoic acid (3-PBA)	Cyhalothrin, cypermethrin, deltamethrin, fenopropathrin, permethrin, tralomethrin
4-Fluoro-3-phenoxybenzoic acid (4-F-3-PBA)	Cyfluthrin
Trans-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (trans-DCCA)	Cypermethrin, cyfluthrin, permethrin

Phthalates

This program will measure urinary metabolites of phthalates (see Table 3). Phthalates are added to plastics, paints, cosmetics, wood varnish, and medical supplies to increase flexibility or improve other characteristics, such as durability. In addition to being in consumer products, phthalates are pervasive in the environment and have been found in food, drinking water, household dust, and indoor air (MDH 2011). Children's behaviors such as mouthing, chewing, and crawling may result in greater relative exposure to phthalates when compared to adults. Phthalate exposure can occur through ingestion, inhalation, and direct contact. Health effects of concern with phthalates include reproductive and developmental outcomes. Three phthalates (BzBP, DBP, and DEHP) are on the Toxic Free Kids Act (TFKA) priority list. MN Biomonitoring has not measured phthalates before.

Table 3. Phthalate biomarkers

Chemical	Parent Compound
Mono-benzyl phthalate (MBzP)	Benzylbutyl phthalate (BzBP)
Mono-n-butyl phthalate (MBP)	Dibutyl phthalates (DBP)
Mono-isobutyl phthalate (MiBP)	Dibutyl phthalates (DBP)
Mono-methyl phthalate (MMP)	Dimethyl phthalate (DMP)

Chemical	Parent Compound
Mono-(3-carboxypropyl) phthalate (MCPP)	Di-n-octyl phthalate (DOP)
Mono-ethyl phthalate (MEP)	Diethyl phthalate (DEP)
Mono-2-ethylhexyl phthalate (MEHP)	Di-2-ethylhexyl phthalate (DEHP)
Mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP)	Di-2-ethylhexyl phthalate (DEHP)
Mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP)	Di-2-ethylhexyl phthalate (DEHP)
Mono-(2-ethyl-5-carboxypentyl) phthalate (MECPP)	Di-2-ethylhexyl phthalate (DEHP)

Flame retardants

This program will measure urinary metabolites of organophosphate flame retardants (OPFRs). (see Table 4). Use of OPFRs is increasing in consumer products such as furniture, electronics, and baby products after the recent phase-out of polybrominated diphenyl ether (PBDE) flame retardants (Ospina 2018, Romano 2017). Some may also be used as plasticizers or lubricants in products. OPFRs are the subject of recent Minnesota state law that went into effect in summer 2019. One OPFR known as TDCPP was the most frequently detected contaminant of emerging concern in groundwater sampling (MPCA 2012). Potential health concerns of OPFRs include carcinogenicity (TDCPP), hormone disruption, and developmental effects. MN Biomonitoring has not measured flame retardants before.

Table 4. Flame retardant biomarkers

Chemical	Parent Compound
Bis(1-chloro-2-propyl) phosphate (BCPP)	Tris(1,3-dichloro-2-propyl)phosphate (TCPP)
Bis(2-chloroethyl) phosphate (BCEtP)	Tris(2-chloroethyl) phosphate (TCEP)
Bis(1,3-dichloro-2-propyl) phosphate (BDCPP)	Tris(1,3-dichloro-2-propyl)phosphate (TDCPP)
Dibenzyl phosphate (DBzP)	Tribenzyl phosphate (TBzP)
Dibutyl phosphate (DBuP)	Tributyl phosphate (TBUP)
Di-o-cresylphosphate (DoCP)	Tricresyl phosphate (TCP)
Di-p-cresylphosphate (DpCP)	Tricresyl phosphate (TCP)
Diphenyl phosphate (DPhP)	Triphenyl phosphate (TPHP)
2,3,4,5-tetrabromobenzoic acid (TBBA)	2-ethylhexyl-2,3,4,5-tetrabromobenzoate (TBB, component in Firemaster 550)

Personal care and consumer product chemicals

This program will measure urinary concentrations of a group of chemicals used in personal care and other consumer products (see Table 5). Some of these chemicals, including phenols and triclosan, are the subjects of a series of state laws and agency exposure reduction activities. BPA is on the TFKA priority list and was widely detected in Minnesota groundwater (MPCA 2012). An MDH pilot project found disparities in parabens and BPA measured in urine of pregnant women (MDH 2013). A multi-agency effort is working to reduce impacts from

exposures to chemicals in consumer products. Potential health concerns from these chemicals include adverse reproductive and developmental effects.

Table 5. Environmental phenol biomarkers

Chemical	Uses
Bisphenol A (BPA)	Polycarbonate plastics, canned food lining, thermal receipt paper
Bisphenol S (BPS)	BPA replacement
Bisphenol F (BPF)	BPA replacement
Triclosan (TCS)	Preservative and antimicrobial agent in soaps, toothpastes, toys, other products
Triclocarban (TCC)	TCS analogue, now phased out
Benzyl paraben (BZP)	Preservatives in PCPs including shampoos, hair products, cleansers, lotions
Methyl paraben (MePB)	Preservatives in PCPs including shampoos, hair products, cleansers, lotions
Ethyl paraben (EtPB)	Preservatives in PCPs including shampoos, hair products, cleansers, lotions
Propyl paraben (PrPB)	Preservatives in PCPs including shampoos, hair products, cleansers, lotions
Butyl paraben (BuPB)	Preservatives in PCPs including shampoos, hair products, cleansers, lotions

Additional analytes

When local partners raise concerns about children's exposure to additional chemicals not on the core list, we will explore the feasibility of adding analytes for regional testing, depending on laboratory capabilities and funding availability.

Sample type

The program will collect a single spot urine sample from participants. For more detail, see "Specimen collection, storage, and transport" below. This sample type is less invasive and offers benefits of ease of collection in young children. Urine is also the appropriate sample type for the analytes of interest in this program.

Methods

Participant recruitment and informed consent

Trained ECS program staff (in most cases with a nursing background) at the recruitment sites will conduct participant recruitment. When eligible families contact the screening program to make an appointment for their child, ECS staff will introduce the program to them, answer any initial questions they have, and gauge their interest in learning more and possibly participating. This will allow the recruitment sites to plan for staffing needs and help families schedule accordingly. Families will have another chance to learn about the program and decide on their participation when they come in for their child's appointment.

When the family comes in for the appointment, they will complete the check-in steps and their child will be escorted to their screening. During this time, the recruiter will approach the family and introduce the program using an accessible, informative overview sheet. The recruiter will describe the purpose, be clear about what the family is being asked to do, summarize the chemicals being tested, and talk about return of results to all families and how findings will be used more broadly. Families will be informed that they will receive compensation for their time and involvement; they will be given a $40 Visa gift card at the end of the visit regardless of ability to collect a sample. Recruitment sites will track Visa card distribution. The recruiter will answer any questions the family has.

If the family is interested in participating, the recruiter will conduct informed consent and have the guardian sign the consent form. Informed consent will include consent for the recruiter to administer a short survey, for the families to collect a urine sample from their child, and for MDH to test for the chemicals included in the program. Families will be told they may be contacted in the future about participating in a follow-up program and can decide at that time if they wish to participate. Families will receive a copy of the consent form with their signature. Assent will not be obtained from the child, as 3-6 year olds do not have the capacity to understand the implications of the program, the chemicals, or the results. Recruiters will leave any explanations up to the family.

Once a family has consented, the recruiter will administer a 15-minute survey (see below) using a script. The script will make it clear that survey information collected will not be part of the student's school record. When the child returns from their screening, the recruiter will instruct the family on how to collect a urine sample (see below). Before the screening appointment begins, each child will be offered a bottle of water to facilitate the urine specimen collection.

For families who prefer a language other than English, non-English-speaking staff and interpreters will be available to talk with families. Relevant languages will be determined ahead of time with ECS staff. A translated short consent form and other materials will be available in the languages used by the school district. Materials will be translated into other languages on an as-needed basis.

All consent forms, contact information, and survey responses will be securely stored and transmitted from the recruitment sites to MDH.

In addition to participation in the biomonitoring program, families who are on private wells will be offered a well testing kit from MDH at no cost. For families also participating in biomonitoring, well results will be paired with the child's biomonitoring results.

Eligibility

Families will be asked whether their child is able to provide a urine sample. If a child is not potty-trained or has any issue that would preclude sample collection, they will be excluded. Only one child per household will be eligible to participate. If siblings are screened on the same day, the oldest child will be selected.

Exposure questionnaire

The survey will be administered in-person by a trained interviewer once informed consent has been received. Interviewers at all recruitment sites will receive the same training in an effort to have interviews conducted in as consistent a manner as possible. Families will answer questions on behalf of their children. As all analytes are short-lived, questions will ask about recent exposure/consumption. Questions will ask about possible exposure sources and demographics, including:

- Occupation of adults in the household
- Drinking water source (private well, community water) and water treatment used
- Frequency of consumption of various foods (rice, fruits and vegetables, organic v. conventional)
- Secondhand smoke exposure
- Home's proximity to agricultural fields (data analysis will also use home address and GIS/mapping to investigate association)
- Frequency of hand washing
- Frequency of use of certain personal care products
- Use of pest control in home
- Race/ethnicity of child
- Parental education
- Household income

Specimen collection, storage, and transport

MDH will provide the specimen collection kits to recruitment sites. Each collection kit will contain a urine collection container, also known as a hat, and a collection bottle. The collection bottle will be labeled with a unique program identification number. This collection method was used successfully to obtain urine samples from 3-6 year olds in Healthy Kids 2018.

Participating families and their child will be given a collection kit and directions to a private bathroom. The recruiter will explain the steps needed to collect the urine sample. Families will also be given a written checklist to take with them during the collection process. They will place the hat across the top of the toilet bowl. The child will urinate directly into the container. The family member will pour the urine into the collection bottle until the bottle is full and place the lid on securely. If there is more urine in the hat than will fit in the collection bottle, the remainder can be poured into the toilet and flushed. The family member will hand the collection bottle to the recruiter. The recruiter will record the collection date and time on a label and place the label on the side of the collection bottle. The collection bottle will be stored in a freezer provided to each recruitment site by MDH.

The samples will be kept frozen and delivered to the MDH Public Health Laboratory (PHL) for analysis.

Data management

All program personnel, including interviewers at recruitment sites, will have completed human subjects training. Confidentiality of program data will be ensured by assigning a unique participant identification number to each participant and maintaining the link between participant ID and name separately from program data. Program data will be entered into a computerized REDCap database residing on a user name and password protected server only accessible to the biomonitoring researchers . No participant data will be individually identified or released to anyone other than the investigators without specific written permission from the participant's family. Paper records will be kept in a locked filing cabinet in a locked office until they can be transferred to MDH staff.

Once written consent is received by the interviewers, MDH will have access to participant contact information and survey responses in the REDCap database. The database will be housed on a secure server and on a secure floor of the MDH building. All physical copies of program data will be filed and kept by the program manager in a locked file cabinet on a secure floor. Individual laboratory analytical results identified only by participant and specimen ID will be sent by the MDH PHL to MN Biomonitoring staff for entry into the secure database. MDH PHL will not have any identifying information for participants.

No individuals will be identified in any reports or publications. Only summary information that does not identify individuals will be public.

Data analysis

The aggregate data analysis has a number of components. All analyses will be performed for each cycle of data and for multiple cycles combined. The analyses will:

1. Characterize exposure to the chemicals measured. We will perform a descriptive analysis of the percent detection, geometric mean, median, and percentiles of all analyte concentrations. We will also determine the percent with elevated levels, defined for arsenic, manganese, mercury, and cadmium.
2. Determine differences between Metro/non-Metro children. We will use analysis of variance, chi square testing, and regression modeling to determine whether significant differences exist between Metro and non-Metro children in exposures. Models will control for other covariates, including age and other factors collected via survey.
3. Identify other disparities in exposure that may exist, including by socioeconomic status, household income, educational attainment, and race/ethnicity. In these analyses, we will consider upper percentiles of exposure as well as geometric mean/medians and percent elevated.
4. Investigate sources of exposure. We will examine associations between chemical concentrations and survey responses to questions about exposure sources using regression modeling and other statistical tests. We will employ geographical information system (GIS) methods to geocode participant addresses and analyze whether proximity to exposure sources such as agricultural fields is associated with higher concentrations of certain analytes.

5. Compare results to NHANES and HealthyPeople 2020 goals. Where possible, we will compare results to other populations, including the National Health and Nutrition Examination Survey (NHANES), which has nationally representative estimates for preschool-age for most analytes in the program. We will also compare results to HealthyPeople 2020 goals where they exist for certain analytes.
6. Produce statewide exposure estimates. Once five years of data are available covering all regions of the state, we will use population weighting methods to calculate statewide estimates.
7. Track regional trends over time. After multiple cycles have been completed in the same region, we will conduct a time trend analysis for the individual Metro and non-Metro regions.

Data will be analyzed using SAS 9.4. Data analysts will be epidemiologists from MDH who are on staff and have completed required MDH data privacy and ethical research trainings.

Communication of results

There will be a two-tiered procedure for returning results to participants and families. In addition, a broad communications plan will share information with communities ahead of recruitment and work with them again to convey findings at the end of each cycle.

Rapid response

For chemicals that have MDH follow-up levels (Table 6), MN Biomonitoring will receive results from the MDH PHL for any participants with elevated concentrations within 30 business days of receipt of samples. MN Biomonitoring will then contact those participants and families as soon as possible. They will receive a phone call from Dr. Mary Winnett, the program physician. During this phone call (with translation available if needed), Dr. Winnett will review results and ask follow-up questions about possible sources of exposure. She will stress that it is important to find and reduce the sources of exposure and describe the resources available to help families do this. She may advise sharing the results with the child's medical provider for follow-up care and re-testing. Families will receive a follow-up mailing with more information on reducing their child's exposure.

Table 6. MDH follow-up levels

Chemical	Follow-up level/Procedure
Arsenic, inorganic	Results with total As ≥20 μg/L will be speciated; families will be contacted if inorganic As >20 μg/L
Cadmium	≥3 μg/L
Manganese	≥0.5 μg/L if on private wells; ≥1.5 μg/L if on public water
Mercury	≥5 μg/L

Individual results return

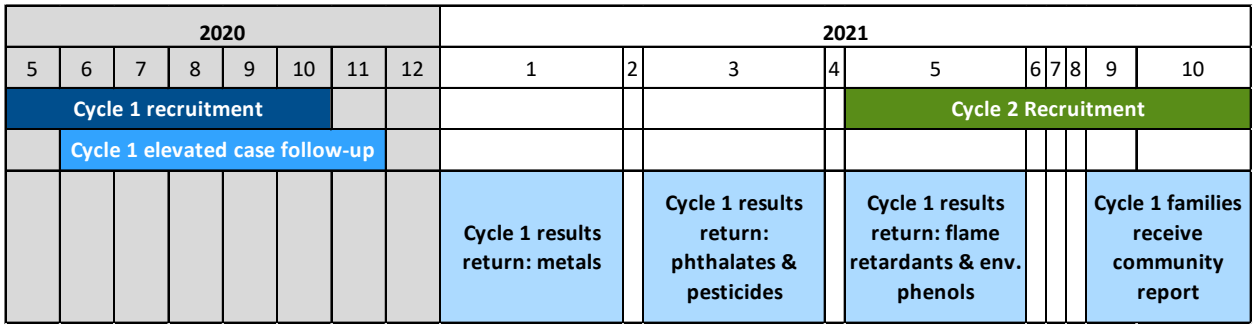
For the remainder of results (analytes not listed in Table 6 and analytes listed in Table 6 with results below MDH follow-up levels), MN Biomonitoring will receive results from the MDH PHL at different time points depending on the status of method development and complexity of analysis. MN Biomonitoring will wait until recruitment and sample collection for each cycle are complete before returning results to all families in that cycle.

Individual results will be returned by mail in three different waves: 1) metals results, 2) pesticides and phthalates results, and 3) flame retardant and environmental phenol results (see timeline in Figure 2). Though exact timing of mailings may be modified, we aim to send families all results for their child within one year of their participation. Families will be informed of this timeline for results return as part of the informed consent process.

Along with their child's results, families will receive information on how to interpret results and what they mean for the child's health. The child's results will be compared with averages from both regions in that particular cycle. Participants will also receive information sheets about ways to prevent exposure to reduce health risks to their children and the rest of their families. Families whose children's results exceed the 95th percentile for the cycle will receive a phone call from MN Biomonitoring staff to discuss the results and ask questions. They will be offered the opportunity to speak with the program physician or the Principal Investigator.

After the results analyses are completed for each cycle/program year, MDH will summarize findings in community reports and mail these to families (see Figure 2).

Figure 2. Timeline of results return



Broader outreach

Ahead of recruitment, MN Biomonitoring will undertake outreach efforts to regional media, such as local newspapers, to inform the public about the program coming to their area and to promote general awareness of biomonitoring and environmental public health efforts. Local public health and other partners can be provided a media kit with talking points and resources in case of reporter contact. MN Biomonitoring will also work with the MDH legislative liaison to make strategic contact with lawmakers when appropriate. In collaboration with partners, MN Biomonitoring will assist with healthcare provider education at the time of results release to help physicians and other providers respond to patient concerns. After the results analyses are completed for each cycle/program year, MDH will summarize findings in community reports

and share findings widely with communities, local public health agencies, school districts, health care providers, and other stakeholders.

Data privacy

All data collected for this program which identifies individuals are classified as private health data under the Minnesota Government Data Practices Act. No individuals will be identified in any reports or publications. Only summary information that does not identify individuals will be public. See the Data Management section for information on how data privacy will be maintained.

Limitations

Selection bias is possible if families choose or refuse to be in the program on the basis of their perceived exposure status or other factors that may be associated with exposure, such as demographics or where they live. There may be other factors or concerns that prevent some families from participating, such as distrust of government entities. Partnering with recruitment staff from ECS programs who work and hold high trust in their communities will help minimize this bias. There may be disparities among other groups not included in the program that we will not be able to detect. Given our sample size, we may not be able to detect some differences in exposure between the groups and stratified analyses on other demographic factors may be limited. The sample collection method of a single spot urine sample has the limitation that the analytes in this program have short half-lives, ranging from hours to days. A single spot sample may miss some relevant exposures. However, the program is designed to collect samples when exposures are most likely to occur. For some analytes, exposures are ubiquitous and ongoing, and thus we would expect to detect low-level exposures even when half-lives are short.

Risks and benefits

There is no health risk to the child. Collection of urine is non-invasive. The results may cause some anxiety for parents whose children have higher exposures, but measures will be taken to allay these fears and provide plain language information that is constructive and reassuring.

There are benefits to the individuals in the program as well as to the larger communities and Minnesota public health exposure reduction efforts. Families will receive their child's individual results when the program cycle is complete, along with information about ways to reduce their exposure to the chemicals studied. If a child has elevated results for arsenic, manganese, mercury, or cadmium, MN Biomonitoring will work with families and partners to reduce exposure. Families on private wells will have the option to receive free private well testing through MDH. Results will be used to identify whether disparities in exposure exist in Minnesota populations, and ultimately to more effectively target available resources and public health actions to reduce exposures.

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Questions for the Panel:

- Are there other survey, demographic or complementary environmental data we should incorporate?
- For private well testing offered as a benefit to participants, how important is it for MDH to get individual-level water data (to link to biomonitoring results)?
- Would you suggest any modifications to the results return protocol?

Inorganic Mercury Screening in Pregnancy to Reduce Harmful Exposures: A Quality Improvement Project

Doctoral nursing student Andrea Jordan will present on clinic screenings for urine mercury. Michael Xiong (MPCA) will recount his experiences conducting home visits for women with elevated urine mercury levels. Panel members are invited to ask questions and provide comments.

Andrea Jordan, RN, BSN, is a dual-degree graduate student at the University of Minnesota, earning a Doctor of Nursing Practice degree in the Family Nurse Practitioner track and a Masters of Public Health with expected graduation in May 2020. She has been coordinating multi-site urine mercury screenings following the MN FEET study from MN Biomonitoring. After board certification she intends to practice primary care with a complementary focus on environmental health policy, thereby improving individual and population health. She has been working closely with MDH and Minnesota Community Care to design and implement an inorganic mercury screening protocol for pregnant women.

Michael Xiong is an Environmental Specialist with the Minnesota Pollution Control Agency. He works on education and outreach on reducing use of mercury in consumer products. While pursuing his Bachelor of Arts in Public Health Science from Hamline University, his senior seminar class laid the foundation of MDH and MPCA's mercury in skin lightening campaign, "Love Your Skin." Prior to joining the MPCA, he worked as a consultant for MDH's Fish Consumption Advisory Program.

Introduction

Women of childbearing age in Minnesota, especially those of East African, Latina, and Hmong ethnicity, may be at increased risk of inorganic mercury exposure through the use of skin-lightening products (MDH, 2017; Adawe & Oberg, 2013). Pregnant women are more likely to use these products in combating pregnancy-related skin changes and may be at a particularly increased risk (Al-Saleh, 2016). There is evidence that inorganic mercury exposure may be harmful on the renal, neurologic, and integumentary systems (Park & Zheng, 2012; Chan, 2011). Despite the clear harm inorganic mercury exposure poses to people, there are currently no guidelines developed for screening at-risk populations.

The aim of this quality improvement project was to increase detection of inorganic mercury exposures in pregnant women through the use of urine mercury screening during the initial prenatal visits in the outpatient clinic setting. There are currently no guidelines for screening or studies examining the costs and benefits of screening and follow-up for inorganic mercury exposures as secondary prevention interventions.

Methods

Setting and Sample

This project was conducted in the largest federally qualified health center (FQHC) in Minnesota, which had previously been identified by the MDH Minnesota Family Environmental Exposure

Tracking (MN FEET) study as serving women at high risk for inorganic mercury exposure (MDH, 2017). This FQHC is composed of multiple clinic sites within a metropolitan area, and the project was conducted at their two largest clinics which had on-site laboratory staff. These clinics serve all ages and ethnicities, including many individuals from the Hmong and Latino communities. All pregnant women who were seen for their first prenatal visit at these two clinics within the project's five-month timeline were screened. Urine collection at this specific visit was chosen because urine testing is standard practice for all initial prenatal visits.

Implementation of this project was unique in that was in conjunction with MDH, who through its recent research on this health phenomenon in Minnesota, has highlighted the need for inorganic mercury screening processes to be developed (MDH, 2017). MDH provided funding for clinical staff time and the MDH Public Health Laboratory (PHL) carried out the urine mercury analysis. Because of this unique context, the key stakeholders within the quality improvement project included the eleven midwives with patient contact at the clinic sites, clinic and MDH PHL staff, and staff with the MDH MN Biomonitoring program.

Intervention

The primary intervention was developing a process to screen pregnant women for inorganic mercury exposure. This was done by adding mercury level laboratory analysis to standard prenatal urine screens that were completed on all pregnant women at their first prenatal visit in the two designated FQHC clinics.

Prior to beginning the intervention, the team of eleven midwives involved with implementation were educated at one of their monthly meetings by this doctoral student on the screening process and timeline. They were given educational materials with an appropriate health literacy level that they could hand out to their patients. They also received a flyer with more detailed information they could use for personal reference in answering questions or researching more deeply on the topic.

Between May 15 and October 18 of 2019, urine specimens were collected by clinic staff through their usual prenatal urine collection process. Midwives explained the intervention and provided education to their patients on the risks of inorganic mercury exposure and possible exposure sources. After collecting the urine sample and sending it to the clinic laboratory, five milliliters of urine were removed from the urine specimen container, re-packaged in a container with preservative provided by MDH, and labeled by clinic laboratory staff. These urine specimens were then frozen for storage and transported to the MDH PHL for analysis. A courier service was contracted by MDH to retrieve specimens once per week from the clinics' laboratory sites and delivered to the MDH PHL.

"Elevated cases" were defined as having a urine mercury result greater than 5 micrograms/liter (mcg/L). For all elevated cases, the MDH PHL notified MDH MN Biomonitoring staff about results. MN Biomonitoring staff followed a protocol for public health response to elevated cases:

- The patient's midwife was informed about results and plan for follow-up via fax to the patient's medical record.

- An MDH-contracted physician called the patient (with language interpretation, if needed) using a script that shared test results and their significance. The physician answered questions, asked follow-up questions about possible sources of exposure, and provided education on exposure sources.
- On the call, the patient was offered a no-charge home visit for exposure identification with a goal of working with the women to identify and reduce likely sources of exposure that pose a health risk to themselves and their families. If the patient agreed to a home visit, MDH notified a local public health agency who was partnered with the MPCA. Together, the local agency and MPCA went to the patient's home (using language interpretation, if needed) to aid in the identification and eradication of mercury exposure through the use of a portable Lumex, a validated and reliable tool used in analyzing mercury vapor.
- A urine re-test was recommended in 2-3 months to be sure exposure levels were decreasing. This time frame was chosen because as soon as exposure is eliminated inorganic mercury is readily excreted from the system with a half-life of ranging from 40 to 60 days.
- Results from the phone call, optional home visit, and follow-up urine testing were communicated to the patient's midwife via fax to the patient's medical record.

Ethical Considerations

This quality improvement project was reviewed for human subject protection using the online Institutional Review Board (IRB) determination tool developed by the University of Minnesota IRB. The responses indicated this project was Quality Assurance (QA)/Quality Improvement (QI) and did not meet the federal definition of Human Subjects Research. This project was also reviewed by the MDH IRB and considered exempt from full review.

Outcome Measures and Data Collection

The primary outcome measure was the number of women screened for inorganic mercury exposure through urine sample collection. Additional outcome measures included: a) the number of women with elevated levels; b) the number of women who received follow-up phone calls; c) the number of women who agreed to and received a home visit; and d) the types of inorganic mercury exposure sources that were removed. Data was collected through audit of the clinics' electronic health record system, the MDH laboratory records, and home visit reports from the MPCA and local public health agencies on whether exposures were identified and removed from the home when possible.

Analytical Methods

Data collected for the quantitative outcome measurements were interpreted through the use of descriptive statistics. There is no data on screening rates prior to intervention implementation because inorganic mercury screening is not currently a routine practice in Minnesota.

Results

A total of 250 pregnant women were screened for inorganic mercury exposure over the five-month project timeline. Of those:

- 165 identified as white, 39 Asian, 33 black or African American, and 13 of unspecified race.
- Reported ethnicity was 160 Hispanic/Latino, 86 not Hispanic/Latino, and 4 undetermined or other.
- Preferred languages were Spanish (133 participants), English (94), Hmong (11), and Somali (4), with single participants preferring other languages, including Amharic, Arabic, French, Karen, Oromo, Tigrinya, and Vietnamese.
- Insurance status included self-pay (129 participants), Medicaid (88), Blue Cross/Blue Shield (17) and other commercial providers (16).

Seven of these screenings resulted in elevated cases, meaning mercury was detected in the woman's urine at levels greater than 5 mcg/L. The prevalence of elevated urine mercury in the clinic's total screened population over this 5-month timeframe was 2.8%. Inorganic mercury levels ranged from non-detectable (lower than 0.367 mcg/L) to as high as 67.7 mcg/L.

Most patients with elevated mercury levels spoke languages other than English as their preferred language. Though numbers of women screened were very small in some groups, 50% (2 out of 4) of women screened who preferred Somali and 27% (3 out of 11) of women screened who preferred Hmong had elevated urine mercury.

Table 1 highlights demographic characteristics and the identified exposure sources of elevated cases specifically.

Table 1. Demographic characteristics of elevated cases

Ethnicity	Race	Preferred Language	Urine Mercury Level (mcg/L)	Mercury Source
Not Hispanic or Latino	Black or African American	Somali	42.8	Skin Product
Not Hispanic or Latino	Black or African American	Somali	67.7	Skin Product
Not Hispanic or Latino	Asian	Hmong	11.3	Skin Product
Not Hispanic or Latino	Asian	Hmong	10.7	Skin Product
Not Hispanic or Latino	Asian	Hmong	17.2	Skin Product

Ethnicity	Race	Preferred Language	Urine Mercury Level (mcg/L)	Mercury Source
Not Hispanic or Latino	White	English	6.85	Thermometer
Hispanic or Latino	White	Spanish	12.0	Skin Product

All seven women with elevated results were contacted by the MDH-contracted physician. Five agreed to home visits, two of whom were visited multiple times. Two women declined a visit. This resulted in a total of seven home visits thus far.

Skin care products were identified as likely sources for six of the seven elevated cases, with one case attributed to the accidental breaking of a mercury thermometer in the home. Mercury contaminated products were identified and voluntarily removed from the homes of two cases. In the remaining four cases, patients described use of suspicious products in the recent past but no products or other potential sources have been physically identified at this time. Investigation is ongoing for these cases, with home visits and skin care product testing still in process by the MPCA.

Discussion

This project reports the effectiveness of conducting inorganic mercury screening for pregnant women aimed at reducing harmful exposures. Results of this project were similar to MDH's MN FEET study, with women preferring to speak Hmong or Somali having a higher proportion of elevated cases. While the total number of screened women with Somali as preferred language was extremely low, they had the highest proportion of elevated results and highest urine mercury levels overall. This signifies that certain populations in Minnesota may have higher risk of mercury exposure through the use of skin-lightening products and suggests the need for continued screening of these groups.

Limitations

This initiative conducted screenings on all women during their initial prenatal visits at the project sites limiting the current data set to women of child-bearing age who are currently pregnant. This was done due to the higher likelihood of exposure and potentially higher consequence for this population when exposed to mercury in skin products. However, skin-lightening products can be used by individuals of any gender and any age. The specific population this project serves limits the ability to generalize these results to a broader population that may also benefit from similar screenings.

Directions for Future Work

This project is a reliable first step in demonstrating that screening for inorganic mercury exposure is not only possible but also clinically important for educating patients and preventing serious health consequences. More education on mercury and skin care products is needed for health care providers and public health officials in order to spread awareness of this emerging public health issue.

Screening processes for inorganic mercury exposure are currently in their infancy, and further work needs to be completed in order to refine the appropriate target population for these screening services and assess the screenings' benefit-cost ratio. Further work also needs to establish standardized guidelines for follow-up practices regarding elevated cases of inorganic mercury.

Funding

This work was supported by the MDH MN Biomonitoring Program.

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Questions for the Panel:

- As we plan to expand clinical screening efforts, what opportunities or barriers should we consider?
- How best can we assess the effectiveness of this work, and to whom should we communicate the results?

Healthy Rural and Urban Kids Updates

Jessica Nelson will give a brief update on the 2018 Healthy Rural and Urban Kids study. Panel members are invited to ask questions and provide comments.

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Section Overview: Other Information

This section contains documents that may be of interest to panel members.

- 2020 upcoming Advisory Panel meeting dates
- Environmental Health Tracking and Biomonitoring Advisory Panel Statute
- Advisory Panel roster
- Biographical sketches of Advisory Panel members
- Biographical sketches of staff

2020 Upcoming Advisory Panel Meeting Dates

Advisory Panel meetings in 2020:

June 9, 2020

October 13, 2020

These meetings will take place from 1-4 pm at

The American Lung Association of Minnesota

490 Concordia Avenue

St Paul, Minnesota

144.998 ENVIRONMENTAL HEALTH TRACKING AND BIOMONITORING ADVISORY PANEL STATUTE

Subdivision 1. **Creation.** The commissioner shall establish the Environmental Health Tracking and Biomonitoring Advisory Panel. The commissioner shall appoint, from the panel's membership, a chair. The panel shall meet as often as it deems necessary but, at a minimum, on a quarterly basis. Members of the panel shall serve without compensation but shall be reimbursed for travel and other necessary expenses incurred through performance of their duties. Members appointed by the commissioner are appointed for a three-year term and may be reappointed. Legislative appointees serve at the pleasure of the appointing authority.

Subd. 2. **Members.** (a) The commissioner shall appoint eight members, none of whom may be lobbyists registered under chapter 10A, who have backgrounds or training in designing, implementing, and interpreting health tracking and biomonitoring studies or in related fields of science, including epidemiology, biostatistics, environmental health, laboratory sciences, occupational health, industrial hygiene, toxicology, and public health, including:

(1) At least two scientists representative of each of the following:

(i) Nongovernmental organizations with a focus on environmental health, environmental justice, children's health, or on specific chronic diseases; and

(ii) Statewide business organizations; and

(2) At least one scientist who is a representative of the University of Minnesota.

(b) Two citizen panel members meeting the specific qualifications in paragraph (a) shall be appointed, one by the speaker of the house and one by the senate majority leader.

(c) In addition, one representative each shall be appointed by the commissioners of the Pollution Control Agency and the Department of Agriculture, and by the commissioner of health to represent the department's Health Promotion and Chronic Disease Division.

Subd. 3. **Duties.** The advisory panel shall make recommendations to the commissioner and the legislature on:

(1) Priorities for health tracking;

(2) Priorities for biomonitoring that are based on sound science and practice, and that will advance the state of public health in Minnesota;

(3) Specific chronic diseases to study under the environmental health tracking system;

(4) Specific environmental hazard exposures to study under the environmental health tracking system, with the agreement of at least nine of the advisory panel members;

(5) Specific communities and geographic areas on which to focus environmental health tracking and biomonitoring efforts;

(6) Specific chemicals to study under the biomonitoring program, with the agreement of at least nine of the advisory panel members; in making these recommendations, the panel may consider the following criteria:

(i) The degree of potential exposure to the public or specific subgroups, including, but not limited to, occupational;

(ii) The likelihood of a chemical being a carcinogen or toxicant based on peer-reviewed health data, the chemical structure, or the toxicology of chemically related compounds;

(iii) The limits of laboratory detection for the chemical, including the ability to detect the chemical at low enough levels that could be expected in the general population;

(iv) Exposure or potential exposure to the public or specific subgroups;

(v) The known or suspected health effects resulting from the same level of exposure based on peer-reviewed scientific studies;

(vi) The need to assess the efficacy of public health actions to reduce exposure to a chemical;

(vii) The availability of a biomonitoring analytical method with adequate accuracy, precision, sensitivity, specificity, and speed;

(viii) The availability of adequate biospecimen samples; or

(ix) Other criteria that the panel may agree to; and

(7) Other aspects of the design, implementation, and evaluation of the environmental health tracking and biomonitoring system, including, but not limited to:

(i) Identifying possible community partners and sources of additional public or private funding;

(ii) Developing outreach and educational methods and materials; and

(iii) Disseminating environmental health tracking and biomonitoring findings to the public.

Subd. 4. **Liability.** No member of the panel shall be held civilly or criminally liable for an act or omission by that person if the act or omission was in good faith and within the scope of the member's responsibilities under section 144.995 to 144.998.

Environmental Health Tracking & Biomonitoring Advisory Panel Roster as of October 2019

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Biographical Sketches of Advisory Panel Members

Kristie Ellickson joined the Minnesota Pollution Control Agency in 2007 after completing her PhD at Rutgers University and postdoctoral work at both Rutgers and the University of Wisconsin-Madison. Prior to her academic pursuits, she was a U.S. Peace Corps volunteer in the country of Panama. As a graduate student and postdoc she conducted research on trace metal speciation and bioavailability in a variety of environmental matrices. Her work at the MPCA includes the incorporation of cumulative risk and impact assessment principles into regulatory risk, the review of human health risk assessments for large permitted facilities, and she has been the lead investigator on an EPA community-scale air toxics grant targeting passive and active air sampling for Polycyclic Aromatic Hydrocarbons in an urban and rural environment.

Farhiya Farah has lived in Minneapolis for 18 years. She received her Bachelor of Science degree from Marymount University, and Masters of Public Health from University of Minnesota where she is also currently completing her PhD. Prior to launching her company, she was employed as a Senior Public Health Practitioner with Minneapolis Health Department where she spearheaded Healthy Homes Strategic Planning for the City of Minneapolis. She is the founder and Principle Consultant of GlobeGlow Consulting and Research that focuses on applied environmental health research (food safety and home environmental assessments), and community based participatory research specializing with Limited English Population. She has provided technical support to a diverse group of partners including state health department, academic institutions, local health departments and community-based organizations. She is an active member of her community, and has volunteered with the City of Minneapolis Department of Health, ECHO Minnesota, and the DHS Barriers to Utilizing Public Health Insurance Study Project Management Team. She is currently a board member of AverageMohamed (counter extremism messaging), and is a core member of the University of Minnesota School of Public Health Somali Initiative.

Tom Hawkinson is the Senor Industrial Hygienist for Wenck Associates in Golden Valley, Minnesota. He completed his MS in Public Health at the University of Minnesota, with a specialization in industrial hygiene. He is certified in the comprehensive practice of industrial hygiene and a certified safety professional. He has worked in EHS management at a number of Twin Cities based companies, conducting industrial hygiene investigations of workplace contaminants and done environmental investigations of subsurface contamination, both in the United States and Europe. He has taught statistics and mathematics at both graduate and undergraduate levels as an adjunct and is on faculty at the Midwest Center for Occupational Health and Safety, which is a NIOSH-sponsored education and resource center at the University of Minnesota's School of Public Health.

Jill Heins Nesvold serves as the Director of Respiratory Health Division for the American Lung Association in Iowa, Minnesota, North Dakota and South Dakota. Her responsibilities include program oversight and evaluation related to asthma, chronic obstructive lung disease (COPD), lung cancer, and influenza. She holds a master's degree in health management and a short-course master's degree in business administration. She has published extensively in a variety of public health areas.

Ruby Nguyen is an assistant professor at the University of Minnesota School of Public Health Division of Epidemiology & Community Health. She received her PhD in Epidemiology from Johns Hopkins University. Ruby's research focuses on maternal, child and family health; the

etiology of reduced fertility; pregnancy-related morbidity, and infertility and later disease. Currently, Ruby is conducting a longitudinal study examining the role of endocrine disrupting chemicals in child development. From 2016-2017, Ruby was Co-Principal Investigator of a statewide prevalence study investigating violence against Asian women and children.

Geary Olsen is a corporate scientist in the Medical Department of the 3M Company. He obtained a Doctor of Veterinary Medicine degree from the University of Illinois and a Master of Public Health in veterinary public health and PhD in epidemiology from the University of Minnesota. For 27 years, he has been engaged in a variety of occupational and environmental epidemiology research studies while employed at Dow Chemical and, since 1995, at 3M. His primary research activities at 3M have involved the epidemiology, biomonitoring (occupational and general population), and pharmacokinetics of perfluorochemicals.

Tracy Sides is a policy analyst with the Public Health Law Center at the Mitchell Hamline School of Law in Saint Paul, Minnesota. She completed her MPH in epidemiology and PhD in environmental health sciences at the University of Minnesota School of Public Health. She has worked for more than 20 years at the interface of public health research and policy at the Minnesota Department of Health, University of Minnesota, and as an executive director of a community-based nonprofit organization in Saint Paul. She has led multidisciplinary policy development and program evaluation initiatives for the World Health Organization and U.S. Department of Homeland Security. Her professional work is focused on the intersection of public policy with environmental and social determinants of health.

Cathy Villas Horns is the Hydrologist Supervisor of the Incident Response Unit (IRU) within the Pesticide and Fertilizer Management Unit of the Minnesota Department of Agriculture. She holds a Master of Science in Geology from the University of Delaware and a Bachelor of Science in Geology from Carleton College and is a licensed Professional Geologist in MN. The IRU oversees or conducts the investigation and cleanup of point source releases of agricultural chemicals (fertilizers and pesticides including herbicides, insecticides, fungicides, etc. as well as wood treatment chemicals) through several different programs. She has worked on complex sites with Minnesota Department of Health and MPCA staff, and continues to work with interagency committees on contaminant issues. She previously worked as a senior hydrogeologist within the IRU, and as a hydrogeologist at the Minnesota Pollution Control Agency and an environmental consulting firm.

Eileen Weber is a nurse attorney and clinical assistant professor at the University of Minnesota School of Nursing. She founded and leads the Upper Midwest Healthcare Legal Partnership Learning Collaborative. She earned her Doctor of Nursing Practice degree in Health Innovation and Leadership in 2014 from the University of Minnesota. She earned her RN diploma from Thomas Jefferson University Hospital in Philadelphia, PA, her BSN summa cum laude from the University of Minnesota, and her JD in the founding class of the University of St. Thomas School of Law in Minneapolis. Her clinical experience and past certifications have largely been in urban critical care and emergency nursing. She has served as vice-president of the Minnesota Nurses Association, earning awards for political action and outstanding service. She represented nursing on the Minnesota Health Care Commission, was a regular editorial writer for the St. Paul Pioneer Press and an occasional op-ed contributor for the Star Tribune. She founded

Friends of Grey Cloud and worked with environmental leaders at the local, regional, state and national levels to protect Lower Grey Cloud Island from harmful development and to conserve the Grey Cloud Sand Dune Prairie. She has extensive experience in legislative lobbying, community activism, and political campaign management. Her scholarly work is focused on the intersection of law, public policy, and interprofessional healthcare practice and education.

Lisa Yost is a Principal Consultant at RAMBOLL ENVIRON, an international consulting firm. She is in their Health Sciences Group, and is based in St. Paul, Minnesota. She completed her training at the University of Michigan's School of Public Health and is a board-certified toxicologist with expertise in evaluating human health risks associated with substances in soil, water, and the food chain. She has conducted or supervised risk assessments under CERCLA, RCRA, or state-led regulatory contexts involving a wide range of chemicals and exposure situations. Her areas of specialization include exposure and risk assessment, risk communication, and the toxicology of such chemicals as PCDDs and PCDFs, PCBs, pentachlorphenol (PCP), trichloroethylene (TCE), mercury, and arsenic. Lisa is a recognized expert in risk assessment and has collaborated in original research on exposure issues, including background dietary intake of inorganic arsenic. She is currently assisting in a number of projects including a complex multi-pathway risk assessment for PDDD/Fs that will integrate extensive biomonitoring data collected by the University of Michigan. She is also an Adjunct Instructor at the University of Minnesota's School of Public Health.

Biographical Sketches of Staff

Carin Huset has been a research scientist in the Environmental Laboratory section of the MDH Public Health Laboratory since 2007. Carin received her PhD in Chemistry from Oregon State University in 2006 where she studied the fate and transport of perfluerochemicals in aqueous waste systems. In the MDH PHL, Carin provides and coordinates laboratory expertise and information to program partners within MDH and other government entities where studies require measuring biomonitoring specimens or environmental contaminants of emerging concern. In conjunction with these studies, Carin provides biomonitoring and environmental analytical method development in support of multiple analyses.

Tess Konen graduated from the University of Michigan's School of Public Health with a master's degree in Occupational Environmental Epidemiology. She completed her thesis on the effects of heat on hospitalizations in Michigan. She worked with MN Tracking for 2 years as a CSTE Epidemiology Fellow where she was project coordinator for a follow-up study of the Northeast Minneapolis Community Vermiculite Investigation cohort. She currently is an epidemiologist working on birth defects, pesticides, and climate change, and is developing new Disaster Epidemiology tools for MDH-HPCD.

Kate Murray is the communications planner for the MN Biomonitoring and Tracking programs. She has a passion for health literacy, particularly through an equity lens. Kate brings experience in creative and technical writing, multimedia production and community engagement. While earning her Master of Public Health degree in Administration and Policy at the University of Minnesota, she also pursued coursework in mass communications and journalism. Prior to joining MDH in April 2019, she worked as a consultant for the American Cancer Society and Collective Action Lab. She also serves as Communications Chair for the Minnesota Public Health Association.

Jessica Nelson is Program Director and an epidemiologist with MN Biomonitoring. She works on design, coordination and analysis of biomonitoring projects, and has been the Principal Investigator for the Healthy Rural and Urban Kids, MN FEET and PFAS studies. Jessica received her PhD and MPH in Environmental Health from Boston University School of Public Health where her research involved the epidemiologic analysis of biomonitoring data on perfluorochemicals. Jessica was the coordinator of the Boston Consensus Conference on Biomonitoring, a project that gathered input and recommendations on the practice and uses of biomonitoring from a group of Boston-area lay people.

Jennifer Plum is the Program Manager for MN biomonitoring. She studied Community Health Promotion while earning her MPH from the University of Minnesota. Prior to joining MDH in December 2019, Jennifer worked with WellShare International, Little Earth of United Tribes, and the U of M Department of Epidemiology and Community Health. She has also been a part of the Health Equity Leadership Network. Jennifer is passionate about health equity, health literacy and community engagement. She is working to connect environmental epidemiology and biomonitoring efforts to community members while coordinating biomonitoring activities.

Kathy Raleigh is an epidemiologist for MN Tracking. She completed her PhD in Environmental Health at the University of Minnesota's School of Public Health and her MPH in Environmental

and Occupational Health at the University of Arizona. She has worked on a variety of environmental health projects including: pesticide exposure in children, occupational asthma, mercury exposure in women and children, and occupational exposure to PFOA. Prior to coming to MN Tracking, Kathy was working on maternal and child health projects both internationally with USAID and, more recently, at MDH. She will also be working on the coordination and collection of hospital discharge data, including heart disease and asthma surveillance projects for MN Tracking with a focus on health disparities.

Blair Sevcik is an epidemiologist with MN Tracking at the Minnesota Department of Health, where she works on the collection and statistical analysis of public health surveillance data for MN Tracking. Prior to joining MN Tracking in January 2009, she was a student worker with the MDH Asthma Program. She received her Master of Public Health degree in epidemiology from the University of Minnesota School of Public Health in December 2010.

Jessie Shmool supervises the Environmental Epidemiology Unit at MDH and is the Principal Investigator for the Environmental Public Health Tracking program. Jessie received her MPH from the Mailman School of Public Health at Columbia University and DrPH from the University of Pittsburgh, where her training and research focused on exposure assessment, GIS and spatial statistics, community-engaged research methods, and environmental health disparities. Prior epidemiology studies have examined social susceptibility to air pollution exposure in chronic disease etiology and adverse birth outcomes.

Lynn Treadwell, Minnesota Public Health Data Portal Coordinator, is an experienced digital communications leader with a solid understanding of websites and application development, social media and digital marketing communications in the health and government sectors. Lynn brings over 10 years of experience in developing optimized online user experiences and digital communications to the position. She will provide stewardship to Minnesota's public health data portal focusing on audience understanding and interactive development best practices. Lynn has an AAS in graphic design, attended the School of Journalism at University of Minnesota and has a mini-Master's in Marketing from St. Thomas University.