

Summary Opinion of Margaret Saracino, M.D.
regarding Morbidity Associated with Methylmercury Exposure
and other Neurotoxic Chemicals Potentially Released by the
PolyMet NorthMet Copper-Nickel Mine Project
December 7th, 2015

Summarized for :
Paula Maccabee, Esq.
Counsel/Advocacy Director for WaterLegacy
1961 Selby Avenue
St. Paul, MN 55014

My name is Margaret Saracino, M.D. and I am a child, adolescent and adult psychiatrist working at a community mental health center in Duluth, Minnesota. I went to the University of Minnesota Medical School and did my residency training at the Mayo Clinic in Rochester, Minnesota. As a medical physician, I have grave concerns about copper-nickel mining and its inherent deleterious effects not only on the environment in Northern Minnesota, but also on human health of those living in that area.

I have read sections of the PolyMet NorthMet environmental impact assessment documents related to potential pollution releases and health impacts of the project and the reports of Dr. Brian Branfireun related to mercury and methylmercury. I defer to Dr. Branfireun and other experts in hydrology, ecology and biochemistry to evaluate the extent of risk that the PolyMet mine project poses in terms of producing substantial increases in levels of mercury, methylmercury or other toxic metals in fish tissue or drinking water. My opinion focuses on the consequences to human health should elevated levels of toxic pollutants result from this mine project.

Copper-Nickel mining is unique in that it produces acid mine waste and sulfates which mobilize releases of heavy metals into the environment, many of which are known neurotoxins, such as lead, methylmercury, manganese, arsenic and toluene. Five of the top 10 pollutants identified by the World Health Organization of major concern to public health are produced by this mining process. To date, there has not been an independent assessment of the human health risk of this form of mining in the water rich area of Northern Minnesota..

“Neurodevelopmental disorders” is a category for many illnesses of the brain and central nervous system. These conditions include diagnoses such as attention deficit hyperactivity disorder, learning disorders, autistic spectrum disorders, language disorders, and intellectual disabilities. Neurodevelopmental disorders have become the new pediatric morbidity, meaning, they are not treatable acute illnesses, but rather are chronic conditions which can only be managed, not cured.

The causes of neurodevelopmental disorders are multifactorial, but toxic exposures to heavy metals, particularly methylmercury, lead, arsenic, and manganese are well known.

In terms of methylmercury, exposure is largely due to ingestion of fish with high mercury content. Methylmercury builds in the food chain. When pregnant women eat fish high in methylmercury, the fetus is then exposed to this lipophilic heavy metal. The placenta is not protective and the blood brain barrier is not well formed until after age two years, which makes fetuses, infants and young children most vulnerable to methylmercury's neurotoxic effects. Neurons in the developing brain multiply at a rapid rate and are particularly vulnerable to toxic effects of heavy metals, hence brain damage is more likely to occur during this vulnerable time. Neurotoxicity is also transferred to the infant through breast milk.

The adverse effects of methylmercury depend on timing and amount of exposure. Methylmercury is a strong toxin that influences enzymes, cell membrane function, causes oxidative stress, lipid peroxidation and mitochondria dysfunction, affects amino acid transport and cellular migration in the developing brain. Exposure in utero can cause motor disturbances, impaired vision, dysesthesia, and tremors. Even lower level exposure can result in lower intelligence, poor concentration, poor memory, speech and language disorders, and decrease in visual spatial skills in children exposed to methylmercury in utero. Fetuses, infants, and young children are four to five times more sensitive to the adverse effects of methylmercury exposure than adults.

Methylmercury can also cause reproductive toxicity such as chromosomal anomalies, low birth weight, reduced fetal survival rate, and fetal deformities.

Methylmercury exposure has also been shown to create free radicals, promote platelet aggregation and blood coagulation, cause sclerosis of the arteries and increase blood pressure, thus raising the risk of myocardial infarction and coronary artery disease. In the case of cardiovascular disease risk, there is a higher toxicity in adults than children.

In addition to the cardiovascular risks, exposure to excess methylmercury may result in neurodegenerative disorders in adults, manifest as tremors, numbness, tingling of the lips, tongue, and extremities. At higher exposures, walking, vision, speech and language, and hearing may be affected. Toxic levels of exposure may be fatal.

In addition to methylmercury, lead is also a byproduct of the copper-nickel mining process. Lead is a known neurotoxin for which no level is considered to be safe. Fetuses and children exposed to lead are at risk for intellectual disability and criminal behavior due to reduced ability to regulate emotions and control impulses. If lead toxicity is not treated before age 5 years, it can cause permanent brain damage. The cost to society of incarceration from criminal activity is high.

There is also a known synergistic effect of neurotoxins, i.e. low level exposures of many neurotoxicants may be additive and together, cause significant harm.

Neurodevelopmental disorders cause significant emotional and financial costs to families and communities. Children with these disorders may require occupational therapy, physical therapy, speech and language therapy. They often require special education services such as a 504 plan or an Individualized Education Plan. They may require outpatient individual and family therapy. All of these services take parents away from their jobs for the needed services and result in financial costs to affected communities, as well as personal suffering and distress.

Comorbid psychiatric conditions are common in children with neurodevelopmental disorders; these include major depression, anxiety disorders, and behavioral disorders, such as oppositional defiant disorder, and conduct disorder. These comorbid conditions often require psychiatric consultation and intervention. If symptoms are severe, the child may need partial hospitalization or day treatment services. In the most severe cases, inpatient hospitalization or residential placement may be needed. All these interventions take an emotional and financial toll on the family and community.

Studies show that the economic costs of lower IQ's are significant. One study showed that each point of decrement in IQ is estimated to decrease average lifetime earning capacity by US \$18,000 in 2008 currency. The most recent estimates from the United States indicated the annual costs of methylmercury toxicity are roughly \$5 billion. Lower and lost wages of parents, loss of jobs for parents, and lost future earnings for individuals with lower IQ's and neurobehavioral disorders reduce the potential for economic growth in the community. Evidence from world-wide sources [Grandjean, Landrigan, Lancet Neurology 2014;13:330-38] shows that average national IQ scores are associated with gross domestic product. Since IQ losses represent only one aspect of developmental neurotoxicity, the total costs are considered much higher.

Resources for children's mental health in Northern Minnesota and nationally are lacking. There is a dearth of psychiatric resources for children in general, and even fewer services available for children with neurodevelopmental disorders. It is not uncommon for a family in Northern Minnesota with a child in a psychiatric emergency to find that the local inpatient psychiatric unit is full. Hence, they may need to wait in the ER for days until a bed, somewhere in or out of state, is available. The need clearly is higher than the current resources.

The Center for Disease Control (CDC), in 2013, identified that only 20% of emotionally disturbed children and adolescents receive some kind of mental health services, and only a small fraction of them receive an evaluation by a child psychiatrist.

Demand for services for child and adolescent psychiatrists was projected to increase by 100% between 1995-2020. Children and adolescents with neurodevelopmental disorders have 3-5 times higher rates of mental, emotional and behavioral disorders than the general population. (National Institutes for Health 2001).

For special populations, such as children with neurodevelopmental disorders, there are few child and adolescent psychiatrists trained specifically to care for their needs. The scarcity of treatment programs for these children increases the risk that they may end up in the criminal justice system by default.

If there is a lack of resources now, what will happen if children in Northern Minnesota are exposed to increase levels of environmental toxins and the incidence of neurodevelopmental disorders, thus, increases?

It is already known, from a study from the Minnesota Department of Health from Nov 2011, that 10% of infants born in Minnesota in the Lake Superior Basin have a higher level of cord blood mercury level than is considered safe by the U.S. Environmental Protection Agency.

More methylmercury in the environment would only result in more neurodevelopmental disabilities and associated mental health issues.

It is my opinion based on concern for my patients and my community that it is imperative that human health risks be assessed prior to going forward with any plan to allow copper-nickel mining in the water rich area of Northern Minnesota. Potential emotional, behavioral and financial costs to our future children, families, communities and society are dangerously high. It is imperative to proceed with caution, as human lives for generations may be adversely affected.

Enclosed:

List of References

Curriculum Vitae of Margaret Saracino, M.D.

REFERENCES

Granjean P, Landrigan P. Neurobehavioral effects of developmental toxicity. *Lancet Neurol* 2014; 13:330-38

Hong, Y-S, Kim YM, and Lee KE. Methylmercury Exposure and Health Effects. *Journal of Preventative Medicine and Public Health*. 2012 Nov; 45 (6):353-363.

Tresande L, Landrigan P, Schechter C. Public Health Consequences of Methyl Mercury Toxicity to the Developing Brain. *Environmental Health Perspectives* May 2005, volume 113, number 5.

Landrigan P, Schechter C, Lipton J, Fahs M, Schwartz J. Environmental Pollutants and Disease in American Children: Estimates of Morbidity, Mortality, and Costs for Lead Poisoning, Asthma, Cancer, and Developmental Disabilities. *Environmental Health Perspectives* July 2002, volume 110, number 7.

Haggerty R, Rothman J. Press IB. *Child Health and the Community*. New York: John Wiley and Sons, 1975

Minnesota Pollution Control Agency, Health and environmental effects of mercury. Website last modified 9/12/13. www.pca.state.mn.us/index.php/topics/mercury/health-and-environmental-effects-of-mercury.html.

United States Environmental Protection Agency, Health Effects of Exposures to Mercury. www2.epa.gov/mercury/health-effects-exposures-mercury.

McCann P. Mercury Levels in Blood from Newborns in the Lake Superior Basin, Minnesota Department of Health, Division of Environmental Health. Nov 2011

Sulfide-Ore Mining Fact Sheet. Northeastern Minnesotans for Wilderness. www.nmworg.org.

American Academy of Child and Adolescent Psychiatry Work Force Fact Sheet: Prevalence and Magnitude of Child and Adolescent Psychiatric Problems

Margaret Saracino, M.D.
1401 East 1st Street
Duluth, Minnesota, 55805
218-728-4491

BOARD CERTIFICATIONS

American Board of Psychiatry and Neurology

Child and Adolescent Psychiatry 1997-Certificate Number 4413

General Psychiatry 1996-Certificate number 43146

EMPLOYMENT

September 1998 to Present

Staff Psychiatrist

Human Development Center- Community psychiatry practice treating children, adolescents and adults in 3 outpatient settings in Northern Minnesota and Wisconsin.

-Provide consultation and collaboration to pediatricians and primary care physicians affiliated with St. Luke's Hospitals and Clinic. This helps increase accessibility of mental health interventions to local children and adolescents. Also provide psychiatric consultation to the Northwood Children's Services CADI homes.

July 1997-July 1998

Staff Child and Adolescent Psychiatrist

-Abbott Northwestern Hospital, Minneapolis, Minnesota-Inpatient and partial hospitalization care to children and adolescents

-Minneapolis Psychiatric Institute-Outpatient psychiatric care to children, adolescents and adults.

July 1994-December 1995

Moonlighting during residency

-Federal Medical Center, Rochester, M

-Faribault Psychological Services, Faribault, MN

-Austin Mental Health Center, Austin, MN

December 1990-July 1991-

Medical Risk Manager-Naval Hospital San Diego, San Diego, CA

EDUCATION

July 1995-June 1997

Fellowship, Child and Adolescent Psychiatry, Mayo Graduate School of Medicine, Rochester, MN

November 1991-July 1995

Residency, Adult Psychiatry, Mayo Graduate School of Medicine, Rochester, MN

June 1990-December 1990

Internship, Naval Hospital San Diego, San Diego, CA

August 1986-June 1990

Medical Degree-University of Minnesota School of Medicine, Minneapolis, MN

September 1980-May 1984

BA degree in Biology-graduated summa cum laude, Drake University, Des Moines, IA

RESEARCH

“Long Term Outcome Study of Anorexia in a Community Based Population.” Presented at the annual meeting of the American Academy of Child and Adolescent Psychiatry, October 1994.

PROFESSIONAL ACTIVITIES

3-4 times from 2003 to 2012- was a faculty who helped teach the *Healer's Art* course at the University of MN Duluth Medical School. This unique course taught the healing art of medicine through large and small group facilitation.

2002-2004- Co-facilitator, Infertility Support Group, coordinated through Northland Obstetrics and Gynecology.

1999- 2005- Board Examiner- American Board of Psychiatry and Neurology, examining candidates in general and in child and adolescent psychiatry.

1995-1997- Co-facilitator of a sexual abuse support group for adolescent females in Rochester, MN.

1994-1995- Co-facilitator of a sexual abuse support group for adult women.

PROFESSIONAL AFFILIATIONS- December 1998 to present -*Clinical Assistant Professor*,
University of Minnesota-Duluth School of Medicine

Member, American Academy of Child and Adolescent Psychiatry

EDUCATIONAL ACTIVITIES

Speak Your Mind- televised local talk show discussing various mental health diagnoses- was a participant 2 times over the last 5 years.

Doctors on Call- participant on a medical panel to discuss issues on Emotional Aspects of Infertility, 2003

1998-present- Have given various lectures in the community for mental health providers and pediatricians on various topics including eating disorders, emotional aspects of infertility, PTSD, Mood and anxiety disorders, ADHD and other behavioral disorders.

February 1996-“Family Violence and Abuse, Clinical Issues”- 2 day seminar presented to Honduran mental health clinicians in Tegucigalpa, Honduras.

April 1996- “Psychiatry in the Alaskan Bush” Mayo Department of Psychiatry Grand Rounds.

November 1993-“Gay and Lesbian Adolescent Suicide” Mayo Department of Psychiatry Grand Rounds.

HONORS

Resident of the Year, Mayo Graduate School of Medicine, 1994-1995

Phi Beta Kappa, 1984

Alpha Epsilon Delta, Pre-Medical Honor Society, 1984

Omicron Delta Kappa, Mortar Board, Scholastic honor societies, 1984

Athletic scholarship for cross country and track, Drake University, 1980-1984

INTERESTS AND ACTIVITIES

Spending time with my family and friends, running, hiking, camping, reading