SUBJECT: Blood Lead Study BOH08012 (City Wide)

RECOMMENDATION:

That the Board of Health approve Public Health Services’ proposal to conduct a Child Blood Lead Prevalence Study, in a targeted area of Hamilton, identified as being at increased risk for lead exposure.

EXECUTIVE SUMMARY:

Environmental lead exposure continues to concern the general public, environmental professionals, researchers, regulators, public health professionals, physicians and politicians. Locally, concerns about lead exposure from drinking water sources triggered a broader review of lead exposures in Hamilton. In older urban municipalities lead exposure from other sources remain the major contributors, including air, food, dust or soil.

This report outlines recommendations being brought forward for a Child Blood Lead Prevalence Study to be completed in the City of Hamilton. The main objective of the study would be to provide an estimate of the prevalence of children living in high risk areas of the Hamilton who have blood lead levels that are above recommended guidelines. In
addition, the issue of how lead in drinking water or exposure to lead from other sources may contribute to the blood lead levels among these children will be explored.

**BACKGROUND:**

*Health Risks of Lead Exposure*

Humans can be exposed to lead in both indoor and outdoor environments. Lead can be found in soil, dust, air, drinking water, food and consumer products.

The human body may absorb lead through inhalation, ingestion, skin contact and may expose a fetus via the placenta. Once lead enters the body it circulates in the bloodstream and either accumulates in tissues or is excreted. Short-term exposure to high lead levels can cause vomiting, diarrhea, convulsions, coma and death. Chronic exposure to lead in adults has been associated with anemia, impaired kidney and nervous system function, and lead has been identified as a probable carcinogen by the International Agency for Research on Cancer (IARC). Children are more at risk of harmful health effects from lead exposure than adults because their bodies and nervous systems are still developing and they absorb and retain a larger percentage of ingested lead per unit of body weight than adults which increases the toxic effects. Low levels of lead exposure have been shown to impair the physical and mental development of children. High levels of exposure among children may cause anemia, kidney damage, muscle weakness, colic, and brain damage, which can ultimately result in death. Fetuses exposed to lead in the womb, because their mothers had a lot of lead in their bodies, may be born prematurely and have lower birth weights and may also experience delayed mental development and consequential lowered intelligence later in childhood. Lead in water is readily absorbed, and is especially available for children who are anemic. This issue raises concerns about children living with issues like poverty who are more likely to experience anemia due to nutritional deficiencies in their diets.

*Measuring Blood Lead Levels*

The blood lead level (BLL) is a measure of the amount of lead circulating in a person’s blood. A blood lead level is used to assess lead exposure, as increases in lead intake are generally considered to reflect increases in exposure. A BLL is most often reported in micrograms per decilitre (µg/dl). The U.S. Centers for Disease Control and Prevention


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(CDC) recommends that children with BLLs greater or equal to 10 µg/dl be considered clinically actionable for environmental assessment of their homes, parent education and further monitoring. It is widely understood that there is no safe level of lead for humans nor is there any evidence of a threshold or level below which lead has no adverse effects.

Sources of Lead

Lead is a heavy metal that occurs naturally in the environment; however, most lead found in high levels in the environment is the result of human activity. For decades, lead has been used extensively in processing, refining and manufacturing processes.

The main sources of lead exposure are air, dust, soil and water.

Air exposure includes lead released from industrial emissions into the atmosphere and can be a major source of environmental contamination, especially near “point sources” such as smelters or refineries. Lead in air was primarily due to the use of organic lead as an additive to gasoline to prevent engine knock. Unleaded gasoline was introduced to the Canadian market in 1975 and leaded gasoline for cars was completely banned in 1990. Since then, lead levels in the air of most Canadian cities have dramatically decreased to well below regulated levels. Air exposure to lead is a particular concern for a city like Hamilton given the heavy industrial presence and documented significant lead emissions in the central city area.

Dust and soil are likely important sources of environmental lead exposure among children. Dust found in the home can contain lead, especially in older homes that have a history of using lead-based paints. Lead was commonly used as an additive to paint until the 1960’s, and in 1976, the Canadian federal government began to place limits on the amount of lead used in interior paint. The use of lead paint in homes built prior to 1960 is believed to contribute to elevated lead levels in dust found in those homes. Due to the activities of crawling, playing on the floor and putting toys and other objects into their mouths, young children can be exposed to lead from dust and dirt tracked into homes. Outdoors, once lead falls onto soil, it sticks strongly to soil particles and remains in the upper layer of the soil so activities involving play in or around dirt can also contribute to lead exposure for young children. Historic uses of lead in products such as gasoline, house paint, and pesticides are important contributors to the amount of lead found in soil. Concerns continue that consumer products such as toys or jewellery may be important sources of lead exposure.

Lead present in drinking water usually comes from any combination of three sources: lead pipes or connections (including service connections to buildings and homes); lead-containing solder used to join pipes; or brass materials such as valves, fittings and fixtures. In May, 2007, the Ontario Ministry of the Environment ordered some municipalities in Ontario to test the lead concentrations in their drinking water systems.

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6 Ibid
9 Supra '3'
Tests conducted in Hamilton in response to this order found that roughly 10% of tap water samples from 20 homes were higher than the maximum acceptable concentration for lead. Elevated lead concentrations were detected in 26.6% of tap water samples collected by Public Works from 786 homes with lead service pipes between May 1, 2007 and February 8, 2008. Public Health Services (PHS) conducted a confirmatory tap water lead survey in those homes with results greater than the MAC (Maximum Allowable Concentration) for lead from October to December 2007. Results of the PHS survey confirm Public Works’ results, estimating that the number of homes with lead water service pipes will have slightly elevated tap water lead levels will vary between 20% to 30% throughout the year.

Ample information exists about population exposures to lead in environmental and occupational settings; especially among infants and children. Most of this information comes from the US whose experience with children’s exposures has been well documented. In contrast, Canada has not produced as much information on children’s exposure to lead especially among ‘ordinary children’. With few exceptions, Canadian studies include children at risk in point source lead emissions or contaminated sites. Currently, Hamilton does not have any data regarding blood lead levels (BLL) among City of Hamilton residents who live in areas that may be at higher risk of environmental lead exposure. As a result, we do not have a clear understanding of the level of risk being experienced by our children. The impact of current guidelines on children’s blood lead levels (and hence exposure) has never been evaluated. New ones are being proposed, including emissions guidelines (standards) in Ontario that are meant to potentially modify exposures at a population level. Without available baseline information, there is no basis to evaluate the impact of these population level interventions.

Nationally, in the United States, the prevalence of elevated BLLs (≥10 μg/dL) (biased towards high risk children) since 1997 has steadily declined from 7.61% to 1.21% in 2006. Based on this information available from the US, the expectation is that Hamilton likely has also experienced a similar decline in BLL in high risk children. Completion of the proposed study would provide evidence as to where Hamilton falls on this downward trend and would provide needed baseline information that would be very useful in informing the development of public health policy and practice strategies aimed at minimizing lead exposure risks.

**ANALYSIS/RATIONALE:**

The study being proposed for Hamilton is intended fill a longstanding gap of quantitative (measurable) information on children’s exposure to lead from environmental sources in the City of Hamilton and would help to provide a basis for support of either existing or newly proposed guidelines and public health programming by using data from the most susceptible group in the population, children 6 years of age and under.

The study’s main objective will be to answer the question of whether or not Hamilton has a lead problem among children residing in a targeted high risk area of the city. A second objective is to explore associated risk factors, and how lead in drinking water or other sources in Hamilton may contribute to lead exposure. The study will be targeted to the population most at risk for the health consequences of lead exposure which is children 6
years of age and under living in home environments where lead service piping and older housing issues such as use of lead-based paints, and exposure to industrial air pollution are more likely. The design of the study will result in an estimation of the prevalence of blood lead levels requiring medical follow-up in this population.

The previously mentioned surveys conducted in Ottawa, Port Colborne and Belledune (NB), primarily investigated soil lead exposure, and only one (Ottawa) conducted water well testing for those whose initial blood lead result was higher than deemed acceptable. We are proposing to include water as a possible source of lead exposure in this study to provide needed information to the Safe Water initiative and to provide education to our communities in further minimizing their lead exposure while using their existing water supply. The information gathered through this study will be important to Hamilton and to many other communities in Ontario which share similar geographical high risk areas. As well, the information provided by this study will be useful to other professionals beyond Public Health who provide health and education services for children. By answering our own local information needs, Hamilton will be recognized for providing an important contribution to the currently available body of information regarding the effects of lead exposure.

Based on the literature, the best time to conduct a BLL survey is during the summer when lead exposure tends to peak. To maximize child participation in the survey, the study should be planned for September, when school begins. Given that risk for lead exposure is associated with several different factors, it can vary greatly across relatively small areas. As such, subjects should be selected from high-risk populations (i.e. children < 6 years of age) and who reside in the City of Hamilton. Any participation by families in this study will be voluntary and full informed consent will be obtained. The study proposal will go through the process to obtain ethics approval.

**ALTERNATIVES FOR CONSIDERATION:**

For the design of the proposed Blood Lead Survey in Hamilton, 2 options were considered.

1) **Case Finding** – This type of study would involve putting a general call out to Health Care Practitioners to identify children under their care in Hamilton who would be recommended for blood lead testing due to concerns about exposure to lead. A study such as this would determine if any children exposed to lead have clinically actionable blood lead levels (BLL) i.e. $\geq 10 \mu g/dL$. Since from other studies, it is recognized that the number of such children is likely to be very low, this type of study may not find any cases and would still not answer the question of whether lead is a problem in Hamilton in this high risk population.

2) **A Prevalence Study** – A targeted prevalence study within the City of Hamilton is the proposed study design. It will provide an estimate of the prevalence (proportion) of children with clinically actionable blood lead levels (BLL) i.e. $\geq 10$ μg/dL.

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μg/dL that can be generalized to the rest of the targeted study population (providing it is based on a random sample) and can therefore be used as a comparator or baseline in the future. It will provide an estimate of the magnitude of the problem in Hamilton so that it will inform a question of public health significance for the targeted area. The intent of the study design is to determine a prevalence that will be generalizable to other children in this age group living in similar high risk communities and if low, we can feel confident that the prevalence for the rest of the City of Hamilton is likely to be equal to or lower than the outcome found.

Options to complete the study on a city-wide scale have been considered but the cost and effort to complete such an exhaustive study would prohibit it being completed. The study area was determined using the map found at Appendix 1 to this report which among other factors identifies waterline sources for homes in Hamilton. The map of the targeted area recommended for the study is found at Appendix 2 to this report.

Based on the literature, the best time to complete a BLL survey is during the summer when lead exposure tends to peak. Our proposal is then to conduct the study at the end of the summer during the months of September and October 2008.

More specifically then, the two objectives of the study are:

1) To determine the distribution of blood lead concentrations and the prevalence of clinically actionable blood lead levels in a sample of City of Hamilton children 6 years of age and under residing in a targeted geographic area considered to be at increased theoretical risk to environmental lead exposure

2) Among these children, to explore the relationship between blood lead levels and the presence of known risk factors such as: age, gender, home renovation in the past 6 months, age of dwelling, parental occupation or hobby that involves lead, etc.

The main components of the study will include:

- Community Awareness campaign
- Identification of a sample of 1,286 children 6 years of age or under who live within the targeted study area.
- Community clinics for blood lead testing of children by finger prick (likely to be planned to occur in schools or day care centres)
- Questionnaire completion by phone interview with children’s parent or legal guardian
- Environmental testing of selected children’s homes for water and soil samples from favourite play areas and yard soil not covered by sod (e.g. gardens)
- Notification of testing results to participants
- Referral for medical assessment for any children identified with clinically actionable blood lead levels. Further environmental assessment and education will be provided by Public Health Services in consultation with the Ministry of the Environment.

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11 Ibid
FINANCIAL/STAFFING/LEGAL IMPLICATIONS:

The expectation is that the estimated budget required for this study will come from the Public Health Research, Education & Development Program (PHRED) for 2008 and that no additional monies from the City of Hamilton will be required to complete the study than what has already been committed in the Public Health budget for 2008. Completion of the study will require an estimated budget of $250,000. Expenses that would fall to this budget would include the estimated cost of $215,000 to out-source the resources to execute the main components of the study listed below.

- Community Awareness campaign including a mailout to all residents of the targeted area. (PHS would manage all the media issues related to the project)
- Identification of a sample of 1,286 children 6 years of age or under who live within the targeted study area.
- Community clinics for blood lead testing of children by finger prick (likely to be planned to occur in schools or day care centres)
- Questionnaire completion by phone interview with children’s parent or guardian
- Coordination of the environmental testing of children’s homes for water and soil samples
- Notification of testing results to participants
- Referral for medical assessment for any children identified with clinically actionable blood lead levels. (Further environmental assessment and education will be provided by Public Health Services in consultation with the Ministry of the Environment.)

Additional costs of up to $35,000 are included for the fees for an environmental health physician, Dr. Lesbia Smith affiliated with the University of Toronto, who would be able to provide expertise and direction on the methodology and analysis for the study.

Discussions have been initiated with the Ministry of the Environment asking them to participate in the study by providing in-kind environmental sample collection and testing for water and soil from the homes of participants. Additionally, similar discussions have been initiated with the Ontario Public Health Laboratory with the Ministry of Health and Long Term Care requesting that the lab partner in the study and provide in-kind blood testing analysis of the study samples. These ministries have both responded positively to considering involvement in this study as the results would be most useful to the work they direct as well. Additional costs could be expected if the outcome of these discussions does not result in their ability to partner in the manner described above with Public Health Services in completing this work.

A project team will be developed. This team will be led by a temporary project manager position created for this purpose (Monies from existing 2008 budget will fund this temporary position, no additional new funding is required). Existing staffing resources
from the Health Protection Division will participate in the project team work of the study planning, the Request-For-Proposals (RFP) process, hiring of the tendered company and then coordination of the completion of the study with them. Following the completion of the study, existing staff will complete the final components of the study which include:

- Data analysis
- Report development and dissemination

**POLICIES AFFECTING PROPOSAL:**

The research proposal will undergo ethics approval through the McMaster Research Ethics Board. The study methodology will ensure that information collected will be done consistent with the Personal Health Information Privacy Act.

Any environmental samples that exceed recommended guidelines will be reported to the Ministry of Environment. If any environmental assessment on public lands identifies lead levels exceeding the recommended guidelines, it would require council to develop a remediation strategy for the affected site.

**RELEVANT CONSULTATION:**

Staff from the Health Protection Division have consulted with Dr. Lesbia Smith, Environmental Health Researcher with the University of Toronto to determine the feasibility and complete the initial planning for the study.

Within the City of Hamilton, consultation with the Public Works Department and Legal Services regarding pertinent aspects of this study proposal are ongoing.

Other consultations regarding participation in the study have included contact with the following:

- Health Canada, Healthy Environments and Consumer Safety Branch
- Ministry of Health and Long-Term Care, Public Health Division
- Ministry of Health and Long-Term Care, Environmental Health Branch
- Ministry of Health and Long-Term Care, Public Health Laboratories Branch
- Ministry of the Environment, Environmental Monitoring and Reporting Branch
- Ministry of the Environment, Standards Development Branch

**CITY STRATEGIC COMMITMENT:**

By evaluating the "**Triple Bottom Line**", (community, environment, economic implications) we can make choices that create value across all three bottom lines, moving us closer to our vision for a sustainable community, and Provincial interests.

Community Well-Being is enhanced. ☑ Yes ☐ No
Environmental Well-Being is enhanced. ☑ Yes ☐ No

Economic Well-Being is enhanced. ☑ Yes ☐ No

Does the option you are recommending create value across all three bottom lines?
☑ Yes ☐ No

Do the options you are recommending make Hamilton a City of choice for high performance public servants?
☑ Yes ☐ No
Appendix A:

Environmental Health

Ages of Water Mains, average property structure age by Census Block, NRCan Metal Recycling Plants and NPRI Lead associated Industries

Legend

- NRPI Lead associated industries* labelled with on-site release totals in kg of Lead
- Metal Recycling Plants**
  - Water mains pre-1950
  - Water mains 1950-1990
  - Water mains post-1990
- Child Study boundary
  - pre-1920
  - 1920 - 29
  - 1930 - 39
  - 1940 - 49
  - 1950 - 59
  - 1960 - 69
- Escarpment
- City Boundary

* These industries were extracted from a database from the following websites: watermains.ca, geocaching.com. The search was based on the (non-exhaustive) list of lead metal recycling companies in Hamilton for the 2006 reporting year. Reporting to the NRPI (National Pollutant Release Inventory) is a legal requirement and mandatory under Canadian law.

** These plants were extracted from a database from the following website: metalrecycling.ca. The websites listed on the database have not been verified or validated by the city of Hamilton. No checking or modifications have been made by the city of Hamilton and the city assumes no responsibility for its accuracy.

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Average year the structure was built on the property based on Assessment data.
Appendix B:

Population of children 0-6 years of age by Dissemination Area (DA) within a Pre-defined Area of Risk for Lead Exposure, City of Hamilton

(based on 2006 Census data)

Legend:
- DA boundaries labeled with the approximate population of children ages 0-6 residing within
- Child Study boundary representing an estimated 8,078 children ages 0-6
- Ward boundaries
- DA (Dissemination Area) boundaries
- Highway
- Major Roads
- Minor Roads
- Escarpment

Note: Since the Census population data was broken into 5 year age intervals with the first being 0-4, the number of children 0-6 was estimated by taking 2/5's of the 0-4 population and adding it to the 0-4 population.

Disclaimer: All information provided is believed to be accurate and reliable. We will make changes, updates and additions as required and make every effort to ensure the accuracy and quality of the information provided. However, the City of Hamilton assumes no responsibility for any errors and we are not liable for any damages of any kind resulting from the use of, or lack of access to, this information. All individual names provided by Hamilton Public Health Services and City Services.

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