

# **The Mid-Atlantic Center for Children's Health & the Environment**

A Pediatric Environmental Health Specialty Unit

Affiliated with the George Washington University School of Public Health & Health Services  
and the  
Children's National Medical Center

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**Testimony of  
Jerome A. Paulson, MD  
before the City Council of Washington DC  
on the matter of Lead in Drinking Water  
4 February 2004.**

Council member Schwartz and other members of the Washington, DC City Council. Thank you for the opportunity to present this testimony today. I am Dr. Jerome A. Paulson. I am a pediatrician and one of the Co-Directors of the Mid-Atlantic Center for Children's Health & the Environment. We are one of eleven Pediatric Environmental Health Specialty Units in the US and we are based at the George Washington University School of Public Health and Children's National Medical Center. I am the Medical Advisor for the Children's Environmental Health Network. I also practice primary care pediatrics here in the District of Columbia.

The Mid-Atlantic Center for Children's Health and the Environment, which serves the District of Columbia and the five states in the Mid-Atlantic region, has two goals: 1) the education of health professionals and others about the scientific and medical aspects of environmental health problems effecting children, and 2) providing advice to physicians, nurses, public health officials, parents, school professionals and others about children who have been, or may have been, exposed to environmental health hazards.

The Children's Environmental Health Network is a national multi-disciplinary, non-profit organization, based in Washington, DC whose mission is to protect the fetus and the child from environmental health hazards and promote a healthy environment.

Lead in the drinking water in some homes in the District of Columbia is a public health problem and the Washington DC Water and Sewer Authority (WASA) needs to resolve this problem as soon as possible. On the other hand, this is not a public health emergency for all of the residents of the District of Columbia who receive their water from WASA.

I will first talk about the toxicity of lead, then the specific issue of lead in water, then the problem of lead in drinking water confronting the District of Columbia and then the overall, and sorely neglected, problem of lead poisoning in the District.

## **Lead Toxicity**

People are exposed to lead through ingestion or inhalation of lead contaminated food, water, or air. When lead enters the body, either via the lungs or the gastrointestinal tract, it moves into the blood stream. Because it is chemically similar to the ubiquitous chemical calcium, it replaces calcium in various bodily processes. Lead then exerts its toxic effects by inactivating crucial enzymes and so halting biochemical pathways essential to normal functioning. The enzymes most sensitive to the effects of lead are in the organ system where we most commonly see symptoms of lead poisoning: the brain. Other organ systems are also at risk from lead toxicity due to enzyme inhibition and impaired iron uptake and processing. These systems include the kidneys, the auditory system, the reproductive system, and red blood cell production.

It is important to recognize that children drink more water per pound of body weight per day than do adults; therefore, if the water is contaminated, they get a larger dose of the contaminant.<sup>1</sup> In addition, children absorb a larger proportion of the lead that they ingest than do adults.<sup>2</sup>

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<sup>1</sup> For example, when an infant drinks six ounces of formula or breast milk per kilogram of body weight daily, it is equivalent to an adult male drinking 35 cans of soda in a day.

The greatest potential for harm from lead occurs in the immature brain; i.e., in children prior to birth and during the first several years of life. Therefore, the offspring-of-pregnant-women and young children who have been drinking lead tainted water are particularly at risk. However, the risk cannot be directly related to the concentration of the lead in the water. The risk is related to how much lead builds up in a child's body.

Blood lead levels above 80 mcg/dL, *which would be exceedingly unlikely from exposures to lead in drinking water alone*, have been associated with coma, convulsions and death. Intermediate blood lead levels, which I also would not expect to occur from this type of exposure, are also associated with significant health effects. Recent research indicates that even children with blood levels below 10 mcg/dL, the level of concern as defined by the US Centers for Disease Control and Prevention sustain a small loss of IQ points. In addition, it is very important to note that many children with elevated lead levels develop attention deficits, language problems, reading difficulties and other learning problems as a result of their exposure to lead. Some children have hearing deficits, short stature, and/or significant behavior problems as a result of their exposure to lead. The behavior problems may be severe enough to result in involvement with the juvenile justice system. These problems may have a greater impact on long-term outcome than the IQ loss. It is lead levels in this range, particularly if the children are also exposed to other sources of lead in their environment, such as lead-based paint, that I believe may occur as a result of drinking lead-tainted water.

Measurable central nervous system injury from lead poisoning does not occur in every instance of exposure. However, if it occurs, it is irreversible. There is no approved medical treatment for children with blood lead levels in the range that we are discussing. Some of the lead will be stored in the body and some will be slowly excreted, but there is no medication or other intervention that will safely remove the lead from the body or reverse any damage that might have been done.

There is at least one case report in the literature of a child sustaining elevated lead levels as a result of lead in water used to dissolve powdered baby formula.<sup>3</sup>

## **Lead in Water**

Lead is going to be a problem in drinking water, if it is present in the source water; but that is not the situation here. In our situation, lead is present in the pipes that carry the water or some of the joints of those pipes or the faucets and other fittings. When lead is present in the pipes, joints, faucets, or fittings then the lead can dissolve into the water as the water sits in the pipes. How much dissolves depends on various chemical characteristics of the water and the amount of time that the water remains in contact with the pipes, joints, faucets, or fittings. The most common cause is corrosion, a reaction between the water and the lead pipes or solder. Dissolved oxygen, low pH (acidity) and low mineral content in water are common causes of corrosion. Presumably,

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<sup>2</sup> Children 0-2 years absorb about 50% of the lead they ingest. Children 2-6 years absorb about 35% of the lead they ingest. Children 6-7 years absorb about 20% of the lead they ingest. Adults absorb about 10% of the lead they ingest.

<sup>3</sup> Shannon M. Graef JW. Lead intoxication from lead-contaminated water used to reconstitute infant formula. *Clinical Pediatrics*. 28(8):380-2, 1989 Aug

it is one or more of these factors that have changed and have caused the increase in the number of homes showing elevated tap-water lead levels in the WASA sampling.

### **Lead in Water in the District of Columbia**

WASA indicates that “[a]pproximately 23,000 properties, about 15% of our customer households, have lead service lines ...” It is these homes that are likely to be at highest risk of elevated lead levels in the drinking water coming out of the tap. It is these homes that should be targeted for intervention.

### **Recommendations for managing medical aspects of the problems of lead-contaminated drinking water in the District of Columbia**

Because irreversible Prevention of further problems should be the primary means of dealing with this problem from here on out. That means reducing the amount of lead present in the water that comes out of the tap. There are methods for chemically treating water to decrease its corrosive potential and thereby decrease that amount of lead that will dissolve in the water. WASA should be required to implement those changes if it has not already done so.

Replacing lead water lines will also reduce this problem in the future, but it will not be a rapid solution to the problem. WASA is required by US EPA regulations to replace 7% of the lead water lines per year. At that pace, in 10 years, there will still be thousands of lead service lines in use. In addition, WASA is only required to replace the line from the street to the property margin. The homeowner is responsible for the remainder. That is going to be a very expensive proposition for some District homeowners. To help homeowners, the District Government should consider developing a system to provide financial aid to enable them to afford to replace these lead lines. Consideration should also be given to whether the District can require a more rapid replacement of lines than is required by the federal government.

WASA should be required, within the next month, to test water samples from all remaining places with known lead service lines. This should not be a passive exercise with WASA relying on homeowners to get test kits, mail them in and interpret the results. Rather, this should be an active program. WASA needs to collect the samples, insure quality control, notify the homeowner of the specific results and publish the overall results.

WASA should be required, within the next 2-3 weeks to directly communicate with all of the properties that it knows to have lead service lines. Those living in the properties should be instructed that they should: 1) run their water for several minutes before using it for drinking or cooking and 2) only use cold water for drinking and cooking. They should be instructed that boiling water will not remove lead and will, in fact, increase the concentration of lead in the water. They should be instructed not to make baby formula with water directly from the tap until the water has been documented to be safe. Those living in the properties should be told that there are water filters that will remove lead and be supplied with a list of those filters certified by NSF International to remove lead

Probably the most important question from a health perspective is whether there is anything that needs to be, and can usefully be, done now to assess the potential health impact of this lead exposure on the offspring of women who have been pregnant while consuming lead contaminated water or on children who have been consuming lead contaminated water. The US Environmental Protection Agency has published The Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) (<http://www.epa.gov/superfund/programs/lead/ieubk.htm>). This computer model attempts to predict blood-lead concentrations (PbBs) for children exposed to lead in their environment. Using this model and entering concentrations of lead in water at the levels that have been reported by WASA, it is obvious that it is unlikely for children to sustain blood lead levels in the 20s and above from the water alone (See appendix). It is also obvious that the children are at risk for sustaining blood lead levels for the single digits into the teens.

There would be particular concern about children who are at risk of having elevated blood lead levels from other reasons, most likely lead based paint in their homes. The elevation of their blood lead level from the water would be on top of the elevation of their blood lead level from paint. In these children, who live in older homes, the homes more likely to have lead service lines, the incremental increase in their blood lead levels may be sufficient to increase their risk of permanent brain damage from the lead exposure.

Unfortunately, it is also important to recognize that there is no approved medical treatment for children with blood lead levels in the range that we are discussing. Some of the lead will be stored in the body and some will be slowly excreted, but there is no medication or other intervention that will safely remove the lead from the body or reverse any damage that might have been done.

Given these facts, should any of the people who have been exposed to lead in drinking water see their physician, have medical tests or any medical interventions? I would recommend that the following criteria be used to decide the answer to this question.

1. Only people living in, or spending many hours per day in, homes with lead service lines should be considered for further evaluation. WASA needs to notify everyone whose home is of concern.
2. Of those people, only those living in, or spending many hours per day in, homes that are known to have had elevated tap water lead levels should be considered for further evaluation. Therefore, it is very important for WASA to complete the water analyses as rapidly as possible as indicated above.
3. Of those people, the greatest risk will be to the children who were born to women pregnant during this episode who consumed WASA water during their pregnancy and children, in the first several years of life, who themselves consumed WASA water.
4. Of those people, based on the information from The Integrated Exposure Uptake Biokinetic Model for Lead in Children I would recommend that
  - a. children under 6 who lived in homes with water lead levels greater than 300 ppb have a blood lead level done
  - b. children under 6 who lived in homes with water lead levels less than 300 ppb and greater than 100 ppb and who live in a home built prior to 1950 or some other significant risk factor such as a neurologic problem or developmental delay have a blood lead level done

- c. other children not have a blood lead level done.
- d. children who have had blood lead levels within the last six months, or who are scheduled to have a blood lead level done within the next one to two months do not need to have a blood lead level done at this time, but should have a blood lead level when next scheduled
- e. all blood lead levels should be drawn as venous blood samples.

There are a number of caveats that need to accompany these recommendations:

- 1. They have not been peer reviewed for scientific soundness
- 2. Different inputs into The Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) will lead to different results, and perhaps, different recommendations.

### **Lead Poisoning in the District of Columbia**

I realize that this is a hearing about lead contamination of drinking water in the District of Columbia. However, I cannot let this opportunity go by without reminding the members of the Council that there are thousands of homes in the District of Columbia that contain lead-based paint. As a result, there are hundreds of children every year in the District of Columbia who sustain brain damage as a result of exposure to this paint.

At the present time we have an inadequate law in the District of Columbia that requires screening of children from 6-9 months of age and again in the second year of life. Screening at 6-9 months is too early to identify children with elevated lead levels.

Moreover, and more importantly, screening children means that we are using children to identify unsafe homes in the District of Columbia. Since there is no known safe level of lead, identifying children with elevated lead levels means identifying children after the damage may have been done.

The District of Columbia needs to work to identify and repair, or have repaired, dwellings that are unsafe for children before the children are harmed. There are ways to do this. The federal government will predicate its future funding for lead programs on this type of approach.

The District needs to change its current law and stop the unethical process of using children to identify unsafe housing. The City Council should convene hearings in the near future to review the entire issue of lead poisoning in the District of Columbia. Major changes need to be made in the way the District and the private sector operate so that children are protected from a problem which is preventable and about which children and their parents have very little control. Council members need to be aggressive and forceful leaders on this issue.

**Deciding on further medical evaluation of individuals who may have been exposed to lead-tainted water.**

Does the home have a lead water pipe?

Yes

No – no further evaluation

Does the home have an elevated water lead level?

Yes

No – no further evaluation

Are there children in the home who are under 6 years of age or a woman who is pregnant?

Yes

No – no further evaluation

Is the lead level in the water greater than 300 ppb?

Yes – have a venous blood lead level done on the child or the infant born to the mother.

No – see below

Is the lead level in the water greater than 100 ppb but less than 300 ppb?

Yes – determine if there are other risk factors\*

Are there other risk factors?

Yes – have a venous blood lead level done on the child or the infant born to the mother.

No – no further evaluation

Is the lead level in the water less than 100 ppb?

Yes – no further evaluation

\*Other risk factors include a home built prior to 1950, a child with a neurological or developmental problem

**Appendix to the testimony of Jerome A. Paulson, MD before the City Council of Washington DC on the matter of Lead in Drinking Water, 4 February 2004.**

The material in this appendix was generated by Dr. Paulson using The Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). This software is available at <http://www.epa.gov/superfund/programs/lead/ieubk.htm>. Each page represents portions of the results generated by the software. Each page differs in the amount of lead that was assumed to be in the drinking water. Particular attention should be paid to the columns headed Blood (ug/dL).

Alternate Water Values Used

Values:

Percent of Total Consumed as First Draw: 50.000%

Concentration of Lead in First Draw: 4.000 ug/L

Concentration of Lead in Flushed: 1.000 ug/L

Percentage of Total Consumed from Fountains: 0.000 %

Concentration of Lead in Fountain Water: 10.000 ug/L

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

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Year	Air (ug/dL)	Diet (ug/day)	Alternate (ug/day)	Water (ug/day)
.5-1	0.021	2.557	0.000	0.231
1-2	0.034	2.655	0.000	0.574
2-3	0.062	3.009	0.000	0.603
3-4	0.067	2.926	0.000	0.621
4-5	0.067	2.869	0.000	0.656
5-6	0.093	3.046	0.000	0.697
6-7	0.093	3.373	0.000	0.711

Year	Soil+Dust (ug/day)	Total (ug/day)	Blood (ug/dL)
.5-1	4.067	6.876	3.7
1-2	6.417	9.681	4.0
2-3	6.479	10.153	3.8
3-4	6.551	10.165	3.6
4-5	4.940	8.532	3.0
5-6	4.475	8.311	2.6
6-7	4.239	8.415	2.4

Alternate Water Values Used

Values:

Percent of Total Consumed as First Draw: 50.000%

Concentration of Lead in First Draw: 15.000 ug/L

Concentration of Lead in Flushed: 3.000 ug/L

Percentage of Total Consumed from Fountains: 0.000 %

Concentration of Lead in Fountain Water: 10.000 ug/L

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

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Year	Air (ug/dL)	Diet (ug/day)	Alternate (ug/day)	Water (ug/day)
.5-1	0.021	2.540	0.000	0.827
1-2	0.034	2.622	0.000	2.042
2-3	0.062	2.977	0.000	2.146
3-4	0.067	2.897	0.000	2.215
4-5	0.067	2.843	0.000	2.342
5-6	0.093	3.020	0.000	2.487
6-7	0.093	3.346	0.000	2.538

Year	Soil+Dust (ug/day)	Total (ug/day)	Blood (ug/dL)
.5-1	4.041	7.429	4.0
1-2	6.340	11.038	4.6
2-3	6.408	11.593	4.3
3-4	6.488	11.666	4.1
4-5	4.896	10.148	3.5

Alternate Water Values Used

Values:

Percent of Total Consumed as First Draw: 50.000%

Concentration of Lead in First Draw: 100.000 ug/L

Concentration of Lead in Flushed: 10.000 ug/L

Percentage of Total Consumed from Fountains: 0.000 %

Concentration of Lead in Fountain Water: 10.000 ug/L

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

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Year	Air (ug/dL)	Diet (ug/day)	Alternate (ug/day)	Water (ug/day)
.5-1	0.021	2.432	0.000	4.837
1-2	0.034	2.420	0.000	11.516
2-3	0.062	2.768	0.000	12.198
3-4	0.067	2.715	0.000	12.685
4-5	0.067	2.677	0.000	13.476
5-6	0.093	2.853	0.000	14.355
6-7	0.093	3.171	0.000	14.701

Year	Soil+Dust (ug/day)	Total (ug/day)	Blood (ug/dL)
.5-1	3.868	11.158	6.0
1-2	5.851	19.822	7.9
2-3	5.960	20.988	7.7
3-4	6.080	21.547	7.4
4-5	4.611	20.831	6.9
5-6	4.192	21.493	6.5
6-7	3.986	21.951	6.2

Alternate Water Values Used

Values:

Percent of Total Consumed as First Draw: 50.000%

Concentration of Lead in First Draw: 200.000 ug/L

Concentration of Lead in Flushed: 20.000 ug/L

Percentage of Total Consumed from Fountains: 0.000 %

Concentration of Lead in Fountain Water: 10.000 ug/L

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CALCULATED BLOOD LEAD AND LEAD UPTAKES:

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Year	Air (ug/dL)	Diet (ug/day)	Alternate (ug/day)	Water (ug/day)
.5-1	0.021	2.316	0.000	9.215
1-2	0.034	2.226	0.000	21.179
2-3	0.062	2.563	0.000	22.591
3-4	0.067	2.533	0.000	23.662
4-5	0.067	2.509	0.000	25.254
5-6	0.093	2.681	0.000	26.982
6-7	0.093	2.990	0.000	27.725

Year	Soil+Dust (ug/day)	Total (ug/day)	Blood (ug/dL)
.5-1	3.685	15.237	8.1
1-2	5.380	28.820	11.3
2-3	5.518	30.735	11.2
3-4	5.671	31.933	10.9
4-5	4.320	32.149	10.5
5-6	3.939	33.696	10.1
6-7	3.758	34.567	9.6

Alternate Water Values Used

Values:

Percent of Total Consumed as First Draw: 50.000%

Concentration of Lead in First Draw: 300.000 ug/L

Concentration of Lead in Flushed: 30.000 ug/L

Percentage of Total Consumed from Fountains: 0.000 %

Concentration of Lead in Fountain Water: 10.000 ug/L

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CALCULATED BLOOD LEAD AND LEAD UPTAKES:

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Year	Air (ug/dL)	Diet (ug/day)	Alternate (ug/day)	Water (ug/day)
.5-1	0.021	2.215	0.000	13.215
1-2	0.034	2.068	0.000	29.522
2-3	0.062	2.394	0.000	31.656
3-4	0.067	2.379	0.000	33.345
4-5	0.067	2.365	0.000	35.717
5-6	0.093	2.534	0.000	38.254
6-7	0.093	2.834	0.000	39.415

Year	Soil+Dust (ug/day)	Total (ug/day)	Blood (ug/dL)
.5-1	3.523	18.974	10.0
1-2	5.000	36.625	14.2
2-3	5.155	39.268	14.2
3-4	5.328	41.119	13.9
4-5	4.073	42.222	13.6

Alternate Water Values Used

Values:

Percent of Total Consumed as First Draw: 50.000%

Concentration of Lead in First Draw: 400.000 ug/L

Concentration of Lead in Flushed: 40.000 ug/L

Percentage of Total Consumed from Fountains: 0.000 %

Concentration of Lead in Fountain Water: 10.000 ug/L

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CALCULATED BLOOD LEAD AND LEAD UPTAKES:

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Year	Air (ug/dL)	Diet (ug/day)	Alternate (ug/day)	Water (ug/day)
.5-1	0.021	2.124	0.000	16.899
1-2	0.034	1.938	0.000	36.890
2-3	0.062	2.253	0.000	39.716
3-4	0.067	2.249	0.000	42.022
4-5	0.067	2.242	0.000	45.140
5-6	0.093	2.407	0.000	48.443
6-7	0.093	2.698	0.000	50.027

Year	Soil+Dust (ug/day)	Total (ug/day)	Blood (ug/dL)
.5-1	3.379	22.423	11.7
1-2	4.686	43.549	16.8
2-3	4.851	46.882	16.8
3-4	5.036	49.373	16.6
4-5	3.861	51.310	16.3
5-6	3.536	54.479	16.0
6-7	3.391	56.209	15.4