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Dr. C. Everett Koop
The Surgeon General
Hubert A. Humphrey Building
200 Independence Avenue, S.W.
Room 712G
Washington, D.C. 20201

Dear Chick:

Ted Tjossem of NICHHD called me last week to ask for some data to use in briefing you on the prevalence of lead exposure and resultant brain impairment. I had intended to bring this matter to your attention at some time after you had settled in more firmly, but he told me you have a special interest in preventing mental retardation. I hope to persuade you that lead exposure is one of the commonest causes of preventable mental retardation and that it is one cause whose complete and permanent remedy is presently within our grasp.

This interest in lead goes back to when I was chief resident at CHOP. That year we admitted more cases of plumbism than ever before, simply because I pressed the residents to do what Bob Kaye and Al Bongiovanni had taught me - think of lead poisoning and then draw a blood for lead in the summertime whenever you see an anemic child, a constipated or irritable child or one with abdominal pain. I became convinced then that there was more lead toxicity than recognized.

I want to make the following points:

1. The threshold for lead effects in children has been lowered from 60 ug/dl to 30 ug/dl in the face of a growing body of epidemiological evidence. It will probably be revised further downward.
2. Animal studies have supported the epidemiological data.

3. Lead encephalopathy has decreased dramatically, but the incidence of excess exposure to toxic doses of lead is higher than anyone had expected.
 4. Lead is a teratogen, and in utero exposure may be a health concern.
 5. Lead may also be involved in the disturbed mentation that can accompany aging.
 6. The monetary costs for low level lead exposure in children are probably well in excess of \$1 billion per year.
 7. Effective prevention is no mysterious problem. It is simply a question of proper determination and good planning.
1. The threshold for lead effects has been lowered. This is still an area of controversy. A number of studies have shown health effects at lower doses, some have not. In 1974, I showed, with Ed Sewell's help, that dentine lead levels in the lead belt of Philadelphia were five times as high as those in the greater northeast and that 20% of the inner city children had dentine lead levels in the range associated with frank toxicity.¹ In 1979, my group, using this marker showed that asymptomatic children with elevated dentine lead levels had lower IQ scores, lower scores in auditory and language processing, and impaired attention. Teachers, blind to their lead level found high lead subjects twice as often to be distractible, disorganized and less able to follow directions.² EEG records or a subsample of high lead children had less midline alpha and more midline delta.³ The mean blood lead in my high tooth lead group was 35 ug/dl. We have followed these children, now fifth and sixth graders, and their school performance remains impaired.⁴ Other studies in England⁵ and in Germany⁶ have since confirmed these findings.
 2. Animal models confirm the epidemiological studies. Lead effects on brain adenylyl cyclase⁷, on synaptogenesis⁸ and brain cytochromes⁹ have been shown at very low doses. Behavioral changes have been demonstrated in the rodent¹⁰ and the non-human primate.¹¹

3. Lead encephalopathy has decreased, but undue exposure is appallingly high. The recent National Health and Nutrition Examination Survey (NHANES II) conducted by the National Center for Health Statistics and FDA was in part a carefully designed study of blood lead levels in a representative sample of Americans.¹³ The methodology is very sound. None of us who worked in the field expected that the prevalence of exposure would be as severe as the data showed. For example:

Percentage of Children 6 months - 5 years
with Blood Leads 30 ug/dl

<u>Annual Family Income</u>	<u>Race</u>		
	<u>All</u>	<u>White</u>	<u>Black</u>
Under \$6,000	10.8	5.9	18.6
\$6,000 - \$14,999	4.2	2.3	12.2
\$15,000 or more	1.2	0.7	2.8

This means that over 600,000 children in the U.S. have blood leads in the dangerous range, that 180,000 black children are at serious risk. It shows that lead is not a problem for blacks alone, but that race and poverty increase the risk dramatically.

4. Lead is a teratogen, and in utero exposure is a concern. A number of studies have shown lead-induced neural tube anomalies.¹³ Lead crosses the placenta, and fetuses are more sensitive than more mature organisms.¹⁴
5. Lead may be involved in the psychopathology of aging. The largest partition of lead is in the skeleton, where it is assumed to be inactive. With advancing age, the skeleton demineralizes. Where does the lead go? Is it possible that some of the disordered mentation associated with aging is lead induced and therefore preventable?
6. The monetary costs attributed to lead exposure are huge, probably well over \$1 billion per year. Cowan and Leviton¹⁵ using my data, estimated the population

attributable risk for poor classroom behavior due to lead as 43%. That is, in Somerville and Chelsea, Massachusetts 43% of the low overall functioning in the first grade could be attributed to elevated lead exposure. Suppose they were incorrect by a factor of 3, and 14% of the poor behavior was lead attributable. This is still a striking figure.

Provenzano¹⁶, an environmental economist, estimated the costs in 1978 dollars for remedial education and medical care as ranging between \$400 million and \$1 billion. He felt this to be conservative. The range requires revision in light of inflation and the altered prevalence figures documented in NHANES II.

7. Effective prevention is no great problem. Lead is easy to measure in the environment and in humans. I do not believe we need debate any longer that it is a powerful and pervasive neurotoxin. It should be removed from the human environment to the technological extent possible. The important sources are:
- a. Houses (old paint is still around)
 - b. Air and dust (gasoline and factory emissions)
 - c. Food (cans and processing)
 - d. Water (in some areas)

If anyone had told me when I entered medical school that smallpox would be nonexistent in 1980, I would have thought them silly. It is not farfetched to visualize eliminating lead intoxication and its attendant effects on children's brains from American society forever. You possess the kind of vision that could accomplish this. There are a number of fine people in HHS who have been working hard on this issue and are very informed. If I can be of use, please do not hesitate to let me know. I would like to come to Washington to talk with you further about this.

Best wishes,

Herb

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