Long-term costs of lead poisoning:
How much can New York *save* by stopping lead?

July 9, 2003 - for questions or comments please contact:

Katrina Smith Korfmacher, PhD[1]
Community Outreach Coordinator
Environmental Health Sciences Center, University of Rochester
Katrina_korfmacher@urmc.rochester.edu
(585) 273-4304

"*As long as attention focuses on the costs of lead-paint abatement and ignores the costs of not abating and as long as people add up the costs of removing paint but not the costs of medical care, compensatory education, and school dropouts, substantial action is unlikely." - Joel Schwartz (1994, p. 105)*

INTRODUCTION:

It is easy to be daunted by the potential costs of making New York's housing lead-safe. Estimates range between under $1000 and $40,000 or more per housing unit; national averages are around $7000 per unit. Although it is harder to quantify the benefits of eliminating lead from housing, these benefits are real and, over time, may actually dwarf current remediation costs. A recent study by Landrigan et al. (2002) estimated that the annual costs of environmentally attributable diseases in American children total $54.9 billion, of which the vast majority ($43.4 billion) arise from lead poisoning.[2] By combining medical and economic research, it is possible to reliably estimate some of these benefits. I have outlined the major potential benefits of eliminating lead poisoning under several categories: lost future income, neonatal mortality, health care costs, special education, criminal justice, and the state infrastructure that currently addresses lead poisoning.

Although I have not addressed this issue in my cost estimates, it is essential to remember that the costs of lead poisoning outlined below are borne by all New Yorkers. However, the costs most directly affect populations that can afford them the least. In 2001, 95% of the children who tested above 10 µg/dL in New York City were non-Caucasian (NYC Dept. of Health and Mental Hygiene, 2001). This implies that lead is one of the most significant issues of environmental justice in this state. While average lead poisoning rates in the population have indeed declined in recent years (NY Dept. of Health, 2000), the rate among the poor and minorities could actually be increasing. The publicly available statewide data does not allow us to investigate this possibility. I urge that analyses be conducted to explore the trends in poisoning rates in New York's oldest and poorest neighborhoods, as this is beyond the scope of my present analysis.

Please note that this is NOT a cost-benefit analysis, since I have not considered HOW these reductions in lead poisoning would be achieved and at what cost. Rather, I have asked, "what costs would the state of New York avoid on an annual basis if lead poisoning due to deteriorated housing were eliminated?" I have made these calculations for the year 1999, since that is the most recent year for which NY DOH statistics have been published.

BENEFITS ANALYSIS

[1] The author thanks the many people who have commented on this document, especially members of the Rochester Coalition to Prevent Lead Poisoning and Dr. James Campbell. Their assistance has been invaluable. However, the author bears full responsibility for the analysis and data interpretation included below.

[2] Landrigan et al. emphasize that this is a conservative estimate, particularly with respect to lead poisoning, because the costs of special education, criminality, medical follow-up, adult diseases to which lead poisoning may contribute, and environmental remediation are not included. In addition, the calculation is based on the blood lead level of 5 year olds, whereas the average BLL for 2 year olds may be higher. They also note that, by comparison, health costs due to motor vehicle accidents are just over 80 billion per year for the entire population.

A. Lost future income

Prior efforts to quantify the impacts of lead poisoning have focused on lost future income. Medical research suggests a strong correlation between EBL and lowered IQ. Economic research shows that lower IQ results in reduced income earned over a person's lifetime. Although this may not in fact be the most significant impact of lead poisoning, it is the best-documented and easiest to quantify. Schwartz (1994) estimates that nearly three-quarters of the quantifiable costs of lead poisoning come from the impact of lowered IQ on earnings potential. Grosse et. al (2002) have recently updated these costs calculations; their estimates are used below.[3]

Table 1a: Potential for increased lifetime earnings

	3% discount rate
Average avoided IQ loss (points)	12
Number of children (0-6) with BLL over 10 in 1999	17,389
Earnings loss/IQ point	$3720
Total annual earnings gain ($)	$776,256,773
NY state gain (10% income tax) ($ per year)	$77,625,677

If we assume an average income tax rate of 10%, these means that NY State is losing nearly $78 million in tax dollars each year from children's earning potential being reduced by lead poisoning. This estimate of benefits that could be gained by eliminating lead poisoning is conservative for reasons discussed in Grosse (2002), including the fact that it does not calculate the effects on children at levels below 10 µg/dL). Recent research implies that, in fact, the rate of IQ loss is higher at these low concentrations (Canfield et al., 2003). In addition, the number of children identified with an elevated blood lead level (over 10) is likely low (see Appendix A).

An alternate means of calculating the lost earning potential was presented by Landrigan et. al. (2002). These authors used the most recently available national average blood lead level of 2.7 µg/dL among 5 year old children. They summarize studies that show the severe impact of lead on reducing IQ at low levels (BLL less than 10). Based on recent research, their estimate assumed that each 1 µg/dL BLL corresponds to a .25 IQ point loss per child, which would result in a 2.39% loss of lifetime earnings. Using a growth rate of 1% and a discount rate of 3%, they calculated the lost earning potential of boys and girls separately in 1999 dollars. Applying Landrigan's national figures to the number of 5 year olds in NY state[4] implies lifetime earning losses of close to $3 billion per year (Table 1b).

Table 1b: Potential for increased lifetime earnings, Landrigan method

	Loss of lifetime earnings	Lifetime earnings	Number of children (5 year olds in 1999)	Total

[3]This calculation makes several assumptions. Based on Grosse et al. (2002), I assume a net present value loss of $3720 per child for each increase of 1 ug/dL. This figure uses a 3% discount rate. I have calculated the benefits that accrue each year, assuming that there were 17,389 0-6 year olds with first-time elevations above 10 µg/dL in 1999. The number of cases of poisoning is based on 1999 data on incidence of blood lead elevations over 10 µg/dL in children under 6 reported by the New York City Department of Health and Mental Hygiene (2001) for New York City and New York Department of Health data (2000) for the rest of the state (See Appendix A). Grosse uses a 'background' level of 2 µg/dL for children in lead-safe housing. I assumed that for children testing over 10 µg/dL, the mean blood lead level was 14 µg/dL (see Appendix A). The benefits in terms of net present value of lifetime earnings per birth cohort (annual benefit) are based on reducing these 17,389 children's blood lead levels by an average of 12 µg/dL to the 'background' level (2 µg/dL) at a benefit of $3720 per child per µg/dL (17,389 * $3720 * 12 = $776,256,773)

[4] According to 2000 US census data, there were 1,239,417 children 0-5 in New York state. To estimate the number of 5 year olds, I divided this figure by 5, then divided by 2 to get the number of boys and girls.

Boys	1.61%	$881,027	123,942	1,758,059,600
Girls	1.61%	$519,631	123,942	1,036,906,097
Total				2,794,965,697

Thus, population-wide New York state may be losing nearly $3 billion from each birth cohort of children. In other words, the vast majority of earnings loss comes from children who are not identified as lead poisoned, either because their BLL is less than 10 or because they were not tested. In addition, this is probably a conservative method since the actual BLL in New York state is probably higher than the national average of 2.7, because of the relatively high percentage of pre-1940 housing in the state. This alternate method of calculation shows that Table 1a (based on children identified with BLL over 10 μg/dL) may be conservative by nearly a factor of four.

B. Neonatal Mortality

As mentioned above, Schwartz's (1994) influential analysis attributes the majority of childhood lead poisoning reduction benefits to increased earning potential. The other significant cost he monetizes is infant mortality (around 16% of total cost). The EPA included this benefit in its 1996 Regulatory Impact Analysis (EPA, 1996), estimating a $1,163 benefit per housing unit abated through avoided neonatal mortality. A 1999 study found a significant increase in spontaneous abortion rates for women with low to moderate lead exposures (Borja-Aburto, et al. 1999).

However, the regulatory impact analysis for HUD's recent lead paint regulations (US HUD, 1999) argued that 1) the link between neonatal mortality and maternal blood lead levels below 10 μg/dL is tenuous; 2) very few pregnant women have blood lead levels above 10 μg/dL; and 3) for those women with very high lead levels, the cause is likely to be occupational and thus would not be addressed by remediation. For these reasons, neonatal mortality was not quantified as a potential cost in the HUD analysis, nor is it here.

C. Health Care Costs

The direct health care costs of lead poisoning include treatment of severely poisoned children (chelation and associated costs) and follow-up and monitoring of moderately poisoned children (lab testing, physician visits, home inspections, etc.). Very few children are chelated each year, usually when the child's BLL is above 45. For example, in New York City in 1995, 163 of the 2727 children with blood lead levels over 20 were chelated (Green, 1998). The greatest proportion of total health care costs accrue from direct treatment of children poisoned at levels between 10 and 45 (non-chelated children). These costs include repeat testing and, at levels over 20, environmental investigation and hazard control of the children's homes. Appendix A describes how these costs were estimated. The estimates given below for the costs of treating lead poisoned children are derived from Kemper et al. (1998).[5]

Table 2: Potential savings due to avoided direct treatment costs

BLL in μg/dL	Number of 0-6 yr olds in NY state in 1999	Cost of follow-up treatment per child (from Kemper, 1998)	Total cost per year
10-14	11502	$55.95	$643,537
15-19	3026	$55.95	$169,305
20-45	2701	$782.6	$2,113,803
45-70	134	$1017.6	$136,358
Over 70	28	$2625.60	$73,517

[5] Kemper et al. estimated treatment costs from a variety of published sources in 1996 dollars (See Appendix A). I have assumed all poisoned children received these treatments. However, it is important to note that Markowitz et al. (1999) suggest that as few as 25% of lead-poisoned children receive proper follow-up care.

Total	17,392		$3,136,519

Of this these total costs, the majority of the medical costs are paid for through Medicaid, since a large proportion of the children who are lead-poisoned are on Medicaid.[6] In addition, all of the environmental investigation and hazard remediation costs are paid for by the State Department of Health (based on these estimates, around $959,109 per year). These costs likely underestimate current medical costs for several reasons: 1) the Kemper figures are in 1996 dollars; 2) problems (behavioral, learning, etc.) related to lead poisoning but not directly associated with treatment of lead may result in additional physician visits; 3) as noted above, the data for number of poisonings in the state may be significantly low.

In addition to these immediate costs of treatment, ongoing research suggests a range of additional health effects of lead poisoning (and related medical costs). Adult hypertension (elevated blood pressure, with increased risk of heart attack and stroke) has been linked to a history of childhood lead poisoning (Kim et al., 1996). If this link is quantified, it could result in significant additional cost implications of lead poisoning. However, because of the lack of data, the HUD analysis cites preventing adult hypertension as a "non-quantifiable benefit," along with "improving children's stature, hearing, and vitamin D metabolism" (HUD analysis, p. 3-51). A recent study by Landrigan et al. (2002) also did not include costs of cardiovascular disease because "a preliminary analysis revealed that these costs were probably minor because of the combined effects of a relatively weak correlation between childhood and adult blood pressures, the resulting modes attributable burden of increased cardiovascular disease, and the severe discounting applied to costs that will arise four or more decades after exposure to lead."

Recent studies have linked lead poisoning and osteoporosis (Escribano et al, 1997; Gruber et al. 1997). Another health cost that has not been quantified is the link between childhood lead poisoning and increased dental caries (Moss, 1999). Altogether, such long-term health costs of chronic conditions may dwarf the direct costs of treating lead poisoned children.

Special Education

Medical research strongly supports the link between lead poisoning and impaired neurobehavioral function. In addition to the IQ effect described above, elevated lead levels have been associated with "lower class standing in high school, increased absenteeism, lower vocabulary and grammatical-reasoning scores, poorer hand-eye coordination, longer reactions times and slower finger tapping…" (Needleman et al., 1990). Therefore, lead poisoning likely contributes to children's need for special education.

According to Schwartz (1994), 20% of children with blood lead levels over 25 need special education (assistance from reading teacher, psychologist or other specialist) for an average of 3 years. In 1998, the average annual cost of special education was $12,833. Based on these assumptions, eliminating lead poisoning could save the state over $7,724,371 annually in special education costs.[7]

Table 3: Potential reduction in special education costs

Number of children, BLL>25	1,270
20% of children, BLL >25 needing special education for three years	254
Cost of three years of special education	$38,199
Total annual benefit	$9,706,454

[6] According to the U.S. General Accounting Office (1999), "83% of children with BLL>+20 µg/dL are Medicaid enrollees.".

[7] Because the number of children in the state with BLL over 25 was not available, I took the proportion of children with BLL over 10 whose levels are over 25 (based on Monroe County Department of Health database, 1996-2000) to be .073. Multiplying this proportion by the total number of children in NY with BLL over 10 (1,270) I derived the estimate of 254 children with BLL over 25 in the state in 1999.

This may be a very low estimate, since recent medical research has shown effects on children's ability to learn at levels well below 25 µg/dL. In fact, recent research has detected significant effects on intelligence at below 10 µg/dL (Canfield et al., 2003; Lanphear, 2000). The special education costs in Table 3 are based solely on the likelihood of a learning disability at BLL over 25 µg/dL. No studies have yet been published on whether or not children with blood lead elevations under 25 µg/dL incur significantly more special education costs.

Criminal Justice

Researchers have suggested that lead poisoning may contribute to delinquent behavior and violent crime as a function of the neurobehavioral impacts cited above (Needleman et al., 1996; Nevin, 1999). Given the high societal costs of criminal activity (costs to victims, incarceration of criminals, etc.) eliminating lead poisoning could potentially create significant benefits to society. The majority of these benefits are currently unquantifiable, however a recent study by Needleman makes it possible estimate the extent of lead's contribution to juvenile delinquency. Needleman (2002) found that "adjudicated delinquents were four times more likely to have bone lead concentrations over 25ppm that controls."[8] However, it is difficult to translate bone lead levels into blood lead levels. Therefore, the approach taken here is to assume that 10% of juvenile delinquency may be attributed to lead poisoning. Based on Needlman's work, this appears to be a conservative assumption; however, additional efforts to quantify the relationship between population-wide blood lead levels and juvenile delinquency would be helpful. Applying this 10% assumption to the cost of residential treatment of juveniles alone, savings could range from $12 to 35 million per year.[9]

Table 4: Potential reductions in residential placement of juvenile delinquents

Attributable risk	Estimated annual benefit based on 1998-99 OCFS budget	Estimated annual benefit based on cost of residential treatment
.10	$12, 343,600	$34,544,000

State Infrastructure for Lead Poisoning

The State of New York subsidizes efforts to educate about, prevent, and respond to cases of childhood lead poisoning. This 'state infrastructure' for childhood lead poisoning would no longer be necessary if lead poisoning were eliminated, although presumably some infrastructure would remain for monitoring, etc. Unfortunately, the costs of this system are very difficult to determine because they are often parts of larger programs and because a large number of entities is involved. The elements of this system are described below and, where possible, cost estimates are given. This infrastructure may be divided into two parts: public health and environmental health.

New York State's Department of Health supports counties' public health programs, including lead poisoning prevention, education, and response. The only part of these monies for which I have an estimate is the supplemental lead poisoning prevention grants, which Ken Boxley of the Department of Health estimates at $8 million per year (personal communication, 2002).

In addition to these public health programs, the state funds environmental health efforts aimed at locating and remediating lead hazards. The figure derived above (see health care costs) for environmental

[8] An earlier abstract of this work indicated that the population attributable risk values range from .11 to .38, depending on race and family income (Needleman 2000). Attributable risk is the additional incidence of delinquency that could be eliminated if lead exposure was eliminated.

[9] These figures are based on the 1998-99 requested budget of the Office of Child and Family Services for "youth facilities" of $123,436,000 (http://www.state.ny.us/dob/archive/989archive/989appd1/ocfs.pdf). However, using the figure of 4813 residential placements statewide (Sickmund and Wan, 2001) at a cost of $80,000 per juvenile per year (personal communications), would yield a total cost of $345,440,000 per year. Thus, the estimates in the table may be low by a factor of two or more. In addition, they do not include the costs of non-residential outcomes for juvenile delinquents.

investigations is certainly a very low estimate of the full costs of environmental investigations ($959,105).

Legal liability

Several legal suits have been brought against municipalities in recent years. While New York City has borne the greatest costs due to legal liability for lead issues, other municipalities have been successfully sued in recent years. The settlements to date have not been a significant cost on a statewide basis, however, there is a potential for many more suits to be brought in future years.

SUMMARY

The estimates given above are all conservative - the benefits may in fact be higher in each category. In addition, it is important to note that some of the most costly impacts of lead (including osteoporosis, hypertension, stroke, and neonatal mortality) cannot be quantified at this time.

It would be inappropriate to give a total of these potential benefits because the range of uncertainty is not known and because of the significance of unquantified effects of lead poisoning. However, this table gives a rough sense of the relative magnitude of the various effects which we can currently quantify. It also shows where improved estimates should be sought. I welcome any comments or suggestions for their improvement.

This summary points to the need for additional research on the societal costs of lead poisoning. While recent updates have been made on the effects of IQ loss on earning potential (Landrigan et al., 2002), these costs may not be of much interest to the state and local governments whose policies significantly determine lead poisoning prevention efforts. These entities are much more likely to respond to costs that represent annual budget items for their level of government, such as Medicaid reimbursement for medical costs, juvenile justice systems, and special education. The estimates given for these costs in this paper are likely very conservative. For example, the figure used to calculate special education costs is based on effects of blood lead elevations that are very high by today's standards (over 25). Especially in light of new research showing IQ effects below 10 μg/dL, it is essential that these estimates be updated. Any research that could improve the reliability and completeness of estimating these costs would likely be very useful to making policy arguments for investing in lead poisoning prevention. Indeed, some day it may be possible to conduct a cost-benefit analysis that supports significant societal investment in reducing lead hazards to prevent lead poisoning

Table 5: Summary of the benefits of eliminating lead poisoning in New York State.

Benefit	Estimate of Annual Benefit	Comments
Increased earning potential	$776,256,773	Estimate based on testing data that may significantly underestimate actual number of lead poisoning cases; "Landrigan method" suggests $2.8 billion earnings loss per year.
Neonatal mortality	Unquantified	Difficult to quantify for both epidemiological and ethical reasons
Health care – direct treatment	$3,136,519	Does not include lead-related problems such as behavioral difficulties
Health care – long term effects	Unquantified	Includes hypertension, stroke, and osteoporosis
Special education	$9,706,454	Probably vastly underestimates costs because does not include needs of children with BLL under 25 µg/dL
Juvenile Delinquency	$12, 343,600	Range is $12 to $35 million if one assumes a 10% attributable risk; due to uncertainty in actual costs of residential treatment, may be even higher. Does not include costs other than residential treatment.
Criminal justice	Unquantified	If effects of lead on juvenile delinquency carry through to adult behavior, costs could dwarf the juvenile costs.
State infrastructure	$8,000,000	Rough estimate of costs of grants to counties for lead prevention work.
Legal liability of municipalities	Unquantified	Only a small number of cases have been settled to date; however there is a much larger potential for future cases.

.

REFERENCES

Borja-Aburto, V.H., I.l Hertz-Picciotto, M.R. Lopez, P. Farias, C. Rios, J. Blanco. 2000. Blood lead levels measured prospectively and risk of spontaneous abortion. American Journal of Epidemiology. 150(9): 590-837.

Canfield, R.L., C.R. Henderson, D.A Cory-Slechta, C. Cox, T.A. Juski, B.P Lanphear. 2003. Intellectual impairment in children with blood lead concentrations below 10 µg per Deciliter. New England Journal of Medicine. 348(16): 1517-1526.

EPA, 1996. "TSCA Title IV, Sections s402(a) and 4040: Target housing and child-occupied facilities final rule regulatory impact analysis." Prepared by ABT Associates.

Escribano, A., M. Revilla, E.R. Hernandez, C. Seco, J. Gonzalez-Riola, L.F. Villa, H. Rico. 1997. Effect of lead on bone development and bone mass: A morphometric, densitometric, and histomorphometric study in growing rats. Calcified Tissue International. 60(2): 200-203.

Green, Mark. 1998. Office of the New York City Public Advocate. www.nmic.org/nyccelp/Documents/Lead-and-Kids-30000-Children.pdf

Grosse, S.D., T.D. Matte, J. Schwartz, and R.J. Jackson. 2002. "Economic gains resulting from the reduction in children's exposure to lead in the United States." Environmental Health Perspectives. 110(6): 563-569.

Gruber, H.E., H.C. Gonick, F. Khalil-Manesh, T.V. Sanchez, S. Motsinger, M. Meyer, C.F. Sharp. 1997. Osteopenia induced by long-term, low- and high-level exposure of the adult rat to lead. Mineraal & Elecotroyte Metabolism. 23(2): 645-73.

Kemper, A.R., W.C. Bordley, and S.M. Downs. 1998. "Cost-effectiveness analysis of lead poisoning screening strategies following the 1997 guidelines of the Centers for Disease Control and Prevention." Arch. Pedeiatr. Adolesc. Med. 152: 1202-1208.

Kim, R., A. Rotnitzky, D. Sparrow, S. Weiss, C. Wager, H. Hu. 1996. A longitudinal study of low-level lead exposure and impairment of renal function: The normative aging study. JAMA 275 (15); 1177.

Landrigan, P.J., C.B. Schechter, J.M. Lipton, M.C. Fahs, and J. Schwartz. 2002. Environmental pollutants and disease in American children: Estimates of morbidity, mortality, and costs for lead poisoning, asthma, cancer, and developmental disabilities. Environmental Health Perspectives. 110(7): 721-728.

Lanphear, B.P., K. Dietrich, P. Auinger, C. Cox. 2000. Cognitive deficits associated with BLLs <10 µg/dL in US children and adolescents. Public Health Rep. 115:521-529.

Markowitz, M. J.F. Rosen, and I. Clemente. 1999. Clinician follow-up of children screened for lead poisoning. American Journal of Public Health. 89(7):1088-1090.

Moss, M.E., B.P. Lanphear, and P. Auinger. 1999. Association of dental caries and blood lead levels. JAMA. 281(24): 2294-2298.

Needleman, H.L., J.A. Riess, M. J. Tobin, G.E. Biesecker, J.B. Greenhouse. 1996. Bone lead levels and delinquent behavior. JAMA. 275(5):363-369.

Needleman, H.L., A. Schell, D. Bellinger, A. Leviton, E. Allred. 1990. The long-term effects of exposure to low doses of lead in childhood: An 11-Year Follow-up report. The New England Journal of Medicine. 322(2): 83-88.

Needleman, H.L. et al. 2000. Bone lead levels in adjudicated delinquents: A case-control study. Pediatric Academic Societies and American Academy of Pediatrics Joint Meeting.

Needleman, H.L.. 2002. Bone lead levls in adjudicated delinquents: A case control study. Neurotoxicology and Teratology 24: 711-717.

Nevin, R. 2000. How lead exposure relates to temporal changes in IQ, violent crime, and unwed pregnancy.

New York City Department of Health and Mental Hygiene. 2001. Preventing lead poisoning in New York City. Annual Report 2001.

New York State Department of Health. 2000. Protecting our children from lead: The success of NY's efforts to prevent childhood lead poisoning.

Schwartz, Joel. 1994. Societal Benefits of Reducing Lead Exposure, Environmental Research. 66: 105-124.

Sickmund, Melissa and Wan, Yi-chun. (2001) "Census of Juveniles in Residential Placement Databook." Online. Available: http://www.ojjdp.ncjrs.org/ojstatbb/cjrp

US Dept. of Housing and Urban Development. September 7, 1999. Economic analysis of the final rule on lead-based paint: Requirements for notification, evaluation and reduction of lead-based paint hazards in federally owned residential property and housing receiving federal assistance.

U.S. General Accounting Office. 1999. Lead poisoning: Federal health care programs are not effectively reaching at-risk children. GAO/HEHS-99-18.

APPENDIX A: DATA SOURCES

These calculations use incidence data - only newly 'confirmed' cases of poisoning. That is, children who were poisoned in previous years and those for whom there is just one finger stick are excluded (confirmation requires a venous sample or two capillary samples). Although including ALL lead poisoned children would give higher costs estimates, using incidence data allows us to think of the costs calculated as annual additional cost (for example, there is no evidence that a child poisoned during two calendar years will need twice as much special education as one poisoned during one year, so this avoids double-counting children who have elevations over several years).

Data New York City are based on 2001 City Health Department figures included in a 2001 annual report by the New York City Department of Health and Mental Hygiene. I used the incidence data for all children poisoned in 1999 (Figure 1, 8,146) and reduced it based on the data for 2001 (total children poisoned under 18 = 5,638; children under 6 = 4,618) to estimate number of children under 6.

Data through 1999 for the rest of the state have been published by the State DOH (NY DOH, 2000). Neither data set is a complete record of lead-poisoned children (testing rates of 83% in the city (percent of children born in 1998 tested at least once before 3rd birthday) and 62% for the rest of the state for the 1997 cohort) and both provide only aggregate data.

In order to determine average BLL, I looked at several distributions of blood lead level (including New York City and Rochester) and concluded that the average BLL of children who are poisoned (BLL over 10) is around 14 µg/dL.

For several of the calculations, I needed a finer distribution of blood lead levels. Based on Monroe County's data, for which a more detailed distribution was available, I made the following assumptions:

Estimated distribution of BLL among lead poisoned children

	Number of children in Monroe County, 1996-2000	Proportion of children in Monroe county	Projected distribution for New York State in 1999
10 to <15	5839	.66	11,502
15 to <20	1536	.17	3,026
20 to <45	1371	.16	2,701
45 to <70	68	.008	134
Over 70	14	.0016	28
Total	8808		17,391

These assumptions should be updated with the actual distribution of statewide poisoning levels if and when that data becomes available to the public.

Direct (follow-up) health care costs

Kemper et al. (1998)[10] provide a comprehensive overview of costs of follow-up care. Nonetheless, some assumptions were necessary to interpret which of these costs apply to which level of poisoning. The following assumptions were used:

[10] The costs used from Kemper et al. (1999, p. 1206) are as follows: Venipunture ($6.53), Lead assay ($17.42), Nurse-only visit ($32), Physician visit ($80), Environmental investigation and hazard removal ($335), Oral chelation ($235), Intravenous chelation ($1843). Note that an additional visit may not always be necessary, as the child may be visiting the physician's office for other reasons. For consistency with the Kemper et al. model, however, the costs of each additional visit have been included here.

BLL in µg/dL	Follow-up measures and average cost	Total cost per child	Number children in NY	Total cost in New York State in 1999
10 to <15	Diagnostic testing (venipuncture + lead assay = $23.95) One additional visit (nurse: $32)	$55.95	11,502	$643,537
15 to <20	Diagnostic testing (venipuncture + lead assay = $23.95) One additional visit (nurse: $32)	$55.95	3,026	$169,305
20 to <45	Diagnostic testing (venipuncture + lead assay = $23.95, 8 times) Eight additional visits ($32 each) Environmental investigation ($335)	$782.6	2,701	$2,113,803
45 to <70	Diagnostic testing (venipuncture + lead assay = $23.95, 8 times) Eight additional visits ($32 each) Environmental investigation ($335) Oral chelation ($235)	$1017.6	134	$136,358
Over 70	Diagnostic testing (venipuncture + lead assay = $23.95, 8 times) Eight additional visits ($32 each) Environmental investigation ($335) Intravenous chelation ($1843)	$2625.60	28	$73,516
Total			13,839	$3,136,519

Data characteristics

The state data are likely to underestimate the prevalence of lead poisoning (see Green, 1998 for examples of underestimation) for several reasons: they include only new cases, exclude children who did not get a follow-up test, and children who were never tested. By way of comparison, Monroe County data which includes all children (regardless of whether they tested positive for lead in previous years) and all test (not just confirmed) yields a total number of poisoning cases nearly four times the state estimate (based on only new and confirmed cases). This should be taken into account in interpreting the data.