



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
POLICY, PLANNING AND EVALUATION

MEMORANDUM

SUBJECT: Blood Lead and Blood Pressure

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SECTION

Thus far, all of EPA's analysis of the health benefits related to the proposed gasoline-lead rulemaking has been for children. Recently, staff members from the Centers for Disease Control, EPA, and the University of Michigan completed and submitted for publication a paper discussing the relationship between blood pressure and blood lead for adults, derived from an analysis of the Second National Health and Nutrition Evaluation Survey (NHANES II).

We found that blood lead levels were a statistically significant predictor of blood pressure in adult males. This relationship held not merely when blood lead was evaluated in a regression with all known factors¹ that have previously been established as correlated with blood pressure; it also held when tested against 89 additional variables representing linear and non-linear functions of every dietary and serologic variable on the NHANES II survey. Recreational exercise, work-related exercise, blood pressure medication, and recent weight loss were

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also considered, and did not effect the size or strength of the relationship. To ensure that the relationship was robust, we included all the variables that, while not significant at the $p = .05$ level, were significant at the $p = .15$ level, and considered every possible combination of those variables. We added all 255 of those combinations to the variables that were statistically significant and performed a regression on each one. The range of variation of the coefficient of the log of blood lead varied by only $\pm 10\%$ from the value we obtained when we included only significant variables, and the highest p-value for lead was still less than .01. We also forced age and age-squared into our regressions, although in the age group we were analyzing (40-59 year-old men) blood pressure is independent of age. Since blood lead levels are correlated with age, this approach reduced both the coefficient and significance level of lead. I have attached to this memo several tables showing the regression coefficients we obtained.

Several other studies have suggested a relationship between blood pressure and blood lead levels in humans,² and experiments on rats confirmed that moderate doses of lead can increase blood pressure and that the effect is restricted to males.³ The rat experiments also suggest a pathway: lead interfering with nerve signals to the muscles around the arteries that control blood pressure.⁴ Some of these studies are attached.

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All of this suggests that the relationship is causal. Moreover, specific analysis to determine whether there is a lower threshold below which lead has no effect on blood pressure showed that the data was best fit with a threshold of zero.

We have examined the public health implications of this relationship using several established correlations between blood pressure and the risk of heart attacks, strokes, and deaths, based upon long-term cardiovascular epidemiological studies. The classic study, which was important in establishing cholesterol as a major factor in the risk of heart disease, was the Framingham study.⁵ Extensive analyses of these data have indicated the probabilities of such coronary events as a function of several variables, including blood pressure. In the 1970's, the National Institutes of Health funded the Pooling Project,⁶ which combined the Framingham data with data from five other long-term studies to improve the accuracy of the risk coefficients. The Pooling Project analyzed the occurrence of serious heart attacks (myocardial infarctions) in white men who entered the study at ages 40-59 and who were followed for at least 10 years. The stroke regressions, also based on a 10-year follow-up, were taken from the Framingham study, as were the estimates of deaths. Because we wanted to predict health outcomes, we also restricted our blood pressure regressions to data on white men aged 40-59. We have used our regression of the relationship between blood lead and blood pressure to predict changes in blood pressure due to the proposed EPA rule, and we have used the Framingham

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and Pooling Project coefficients of the risks of heart attacks, strokes, and deaths as a function of blood pressure to predict the health outcomes.

To produce estimates for all 40-59 year old white males, the individual risk of each person sampled in the NHANES was summed and then averaged. Since the sampled individuals represent the U.S. population for their specific age-race-sex category, their average risk represents the average risk for all 40-59 year old white men. Because blood lead levels have dropped from the NHANES period until now, we corrected for that change and then evaluated the effects of EPA's proposed rule. Only white men were examined because there were too few blacks in the Framingham study, and their risk might be different from whites. However, we did predict the change in the number of males with high blood pressure for both races because the based data we used (the NHANES) has adequate information on both blacks and whites.

The fact that gasoline lead levels would slowly decline even without new EPA actions created a slight complication. Because gasoline lead levels fall over time in both our base case and the low-lead case, the difference in blood lead levels resulting from the proposed rule will change over time. Therefore, we recalculated the risk estimates for each year, assessing the change in blood lead levels for that year due to the proposed rule.

The heart attack regressions predict the occurrence of myocardial infarctions (MI's) in the next 10 years, given current blood pressure and age. Lacking contrary information, we have

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assumed MI's are uniformly distributed over time, i.e., one-tenth of the heart attacks would be avoided each year of the 10-year predicted period. We applied the same technique to strokes and deaths. The population at risk was adjusted for the increases in the U.S. population of white males aged 40-59; and the regression predicting deaths for ages 40-54 was extended to 40-59 for data comparability and uniformity. Because the death rate actually increases with age, this is a conservative estimate. Predictions of the change in the number of males aged 40-59 with hypertension include both races, since again in this case we used the NHANES data.

Based on this approach, the estimates for each year were computed and are shown on Table 1, for EPA's proposed rule* (0.10 grams per leaded gallon (gplg) in 1986), and for the alternative rule** discussed in the preamble to the proposed rule (0.50 gplg on July 1, 1985; 0.30 gplg on January 1, 1986; 0.20 gplg on January 1, 1987; and 0.10 gplg on January 1, 1988).

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Table 1

Estimated Reduction in the Number of Heart Attacks,
Strokes, and Deaths Due to Lead Phase down
(While Males Aged 40-59)

<u>Heart Attacks</u>								
Year	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>
*PROPOSED RULE	0	5348	4821	4584	4241	3899	3928	3821
**ALTERNATIVE	2719	3758	4095	4584	4241	3899	3928	3821

<u>Strokes</u>								
*PROPOSED RULE	0	1737	1564	1487	1375	1263	1271	1236
**ALTERNATIVE	887	1256	1331	1487	1375	1263	1271	1236

<u>Deaths</u>								
*PROPOSED RULE	0	5904	5322	4963	4680	4303	4302	4333
**ALTERNATIVE	2353	3708	3933	4963	4680	4303	4302	4333

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Estimated Reduction in the Number of Males
Aged 40-59 with High Blood Pressure

Year	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
*PROPOSED RULE	0	1,681,000	1,499,000	1,100,000
**ALTERNATIVE	896,000	1,244,000	1,290,000	1,100,000

Year	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>
*PROPOSED RULE	1,300,000	1,190,000	1,185,000	1,150,000
**ALTERNATIVE	1,300,000	1,190,000	1,185,000	1,150,000

Table 2 presents our estimates of the monetized benefits of avoiding these heart attacks, strokes, deaths, and cases of hypertension. The methodology used to derive the estimates follows the table. For convenience, deaths from heart attacks and strokes are valued under the heart attacks and stroke categories. The remaining deaths are valued separately.

Table 2

Benefits of Avoiding Heart Attacks, Deaths,
Strokes, and Hypertension Due to EPA's
Proposed Gasoline Lead Regulations*
(millions of 1983 dollars)

Benefits of Avoided Heart Attacks

<u>Year</u>	1985	1986	1987	1988	1989	1990	1991	<u>1992</u>
*Proposed Rule	0	2979	2685	2553	2362	2171	2188	2128
**Alternative	1514	2149	2281	2553	2362	2171	2188	2128

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Benefits of Avoided Deaths

*Proposed Rule	0	2848	2568	2371	2283	2099	2060	2152
**Alternative	797	1502	1593	2371	2283	2099	2060	2152

Benefits of Avoided Strokes

*Proposed Rule	0	782	704	699	619	568	572	556
**Alternative	399	565	599	699	619	568	572	556

Benefits of Avoided Hypertension

*Proposed Rule	0	370	330	237	286	262	261	253
**Alternative	197	273	284	237	286	262	261	253

Total Benefits

<u>Year</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>
*Proposed Rule	0	6,979	6,287	5,860	5,550	5,100	5,081	5,089
**Alternative	2,907	4,489	4,757	5,860	5,550	5,100	5,081	5,089

*The proposed rule would reduce the lead content of gasoline to 0.10 grams per leaded gallon (gplg).

**The alternative rule would reduce lead to 0.5 gplg in July 1985, 0.30 in January 1986, 0.20 in January 1987, and 0.10 in January 1988.

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COST OF CORONARY DISEASE

Coronary heart disease is not merely a major cause of mortality and morbidity in the United States; it accounts for a significant fraction of total U.S. medical expenditures (now approximately 10 percent of the Gross National Product) and results in substantial productivity loss due to reduced participation in the labor force of people in their peak productive years. We have estimated the benefits of avoiding the mortality, medical expenses, and reduced labor force participation that would result from the predicted decrease in coronary events due to reductions in blood lead levels resulting from EPA's proposed rule.

To estimate the value of avoiding such losses, we have generally followed Hartunian et al. (1981),⁷ who recently completed a detailed analysis of the costs of various diseases.

Medical Costs

Briefly, Hartunian divided coronary heart disease into five subcategories: sudden death, fatal myocardial infarction (fatal MI), non-fatal myocardial infarction (non-fatal MI), coronary insufficiency, and angina pectoris uncomplicated.

For each category and each age group, Hartunian et al. obtained data on the type of medical services needed (e.g. ambulance, coronary intensive care unit, etc.), the fraction of cases using each service, and the costs in 1975 dollars. They also determined the annualized recurrence and follow-up costs, by

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age, for each condition. These were then present-valued (using a 6 percent real discount rate) to the time of initial occurrence to estimate the cost, in current dollars, of each new case. Hartunian also obtained data indicating the probability distribution of cases among the four categories. We are concerned only with sudden death, fatal MI, and non-fatal MI. Approximately 77.5 percent of these events are MI's, of which 2.4 percent are fatal for males under 55, and 7.7 percent are fatal for males over 55. The rest of the events are sudden deaths.⁸ The present value of the direct medical costs for males aged 40-59, in 1975 dollars, was \$96 for sudden death and \$7,075 for all MI's, including fatal MI's.

We have done three things to adjust these costs to 1983 dollars. First, we inflated them to 1983 costs. Since most of the costs were hospital-related, with the rest principally being physicians' fees, we inflated Hartunian's costs by a weighted average of 80 percent of the percent change in the Consumer Price Index for hospital rooms and 20 percent of the change in the Consumer Price Index for physicians' expenses. Since approximately 90 percent of Hartunian's MI costs were hospital-related, not physicians' fees, this approach is conservative.

Second, cost indices only account for the increase in cost of the same procedure, in this case principally the initial hospitalization for a heart attack; it does not provide the cost of new or different procedures. Since 1975, however, the fraction of people suffering coronary heart disease who subsequently undergo

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coronary bypass operations has substantially increased. The number of bypass operations tripled in seven years, from 57,000 in 1975 to 170,000 in 1982,⁹ while the number of cases of coronary heart disease has remained relatively constant. Based on Hartunian's data, in 1975, 7.1 percent of MI cases had subsequent bypass operations. Assuming that they shared proportionately in the tripling of the bypass-operation rate, we estimated that an additional 14 percent of MI's now result in a bypass operation. Hartunian estimated the cost of bypass operations at \$6,700 in 1975 dollars, or \$16,800 in 1983 dollars. Adding 14 percent of this cost to the other direct costs yields an estimate of the total direct costs in 1983 dollars: \$20,100 for an MI and \$240 for sudden death.

Third, Hartunian only used a 6 percent real discount rate to present value the future year costs, whereas OMB requires a 10 percent discount rate. Fortunately, Hartunian performed sensitivity calculations for other discount rates, including 10 percent. Using this adjustment, the costs per case are \$18,100 for an MI and \$216 for sudden death, with a weighted (by incidence rate) average cost per event of \$14,076.

Foregone Earnings

Hartunian also calculated foregone earnings based on reduced labor force participation using data for all four categories of coronary heart disease, broken down by sex and 10-year age categories. We have again adopted his basic results, with one substantial difference.

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Hartunian valued fatalities by the foregone income that person would have earned had he or she continued to a normal life expectancy. This "human capital" approach to valuing mortality has been critized as an estimate of the value of avoiding the risk of death, because it places no value on avoiding the death of non-participants in the labor force (e.g., retiree's, the handicapped, housewives), nor does it correctly reflect the willingness of people to pay for reductions in the risk of death. For these reasons, we valued fatalities separately from foregone earnings.

We then adjusted Hartunian's foregone earnings estimate, by age category, to exclude fatalities. The revised estimates were also adjusted for the increase in average non-farm compensation from 1975 to 1983, using data from Data Resources, Inc. (DRI), and for the use of the OMB-required 10 percent discount rate, rather than Hartunian's 6 percent discount rate, to determine the present value of future earnings.

This yields \$90,000 in foregone earnings for non-fatal heart attack victims under 45 years old; \$47,000 in foregone earnings for victims between 45 and 54 years old; and \$22,000 in foregone earnings for victims over 55 years old. Based on the data from the Pooling Project and the NHANES, 16.1 percent of the non-fatal heart attacks in this age group occur in men under 45, 50.9 percent occur in men 45-54, and 33 percent occur in men over 54. Therefore, the weighted average of foregone earnings is \$45,600 per event.

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Fatality Costs

The reason for not using lost wages as our measure of the value of avoiding the risk of death is that it does not accord with economic theory. We live in a market economy, and in general, the value of goods and services is determined by what people are willing to pay for them, rather than by some absolute sense of what they are "worth".

People are willing to pay an unlimited amount to save their own lives, and indeed when an identifiable individual's life is in jeopardy, society as a whole is willing to spend large sums to preserve it. However, that is not the situation with which we are dealing. There are no identifiable individuals who will die if their blood pressure rises a few millimeters; rather, their risk of death increases by a small amount. Risk, not life, is the object we are trying to value. People make decisions that trade off risk against other things, including money, all the time. For instance, when purchasing a car, consumers compare price, quality, styling, and how safe the car is. Or, construction workers who weld the steel skeletons of skyscrapers are paid higher wages than workers in less risky building construction. Economists have studied such situations to estimate the "risk premium" in wages. For convenience, in comparing the results of different studies, the risks and risk premiums involved are multiplied by the population exposed to obtain a risk premium per statistical life saved. While this is the most convenient way to express the result, we must remember that we are really measuring

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the willingness of large numbers of people to pay to reduce their individual risk by an amount which, when summed over all of them, has an expected savings of one life, and not the value to save a specific individual's life.

This said, economic research to date has indicated that people, on average, are willing to pay between half a million dollars and seven million dollars to reduce the risk that produces one statistical life saved. For example, Smith (1976)¹⁰ regressed the log of wage rates against educational level, work experience, union membership, firm size, occupational category, full or part time work, marital status, health status, size of urban area, region of the country, industry category, and the accidental death rate per 1 million human work-hours, using data from the 1973 Current Population Survey and the 1970 Bureau of Labor Statistics Injury Reports. The variable for the risk of death (death rate per million work-hours) was highly statistically significant and suggested that workers required compensation for increasing their risk of death at a level of \$3.22 million (1983 dollars) per statistical life saved. We have used a value of \$1 million per statistical life saved to value reductions in the risk of dying from a heart attack due to lowering blood pressure. Obviously, this is near the bottom end of the range and, therefore, conservative.

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Mortality Rates

All of the sudden death cases and fatal MI's need to be valued by the method above. But also, in addition to the immediate mortality associated with myocardial infarctions, patients who survive their first heart attack are at substantially increased risk of dying subsequently. Goldberg et. al. (1979)¹¹ studied hospital discharges for myocardial infarctions in Baltimore to compare prognoses. Life-table analysis of the data yields the following rates for survival.

Table I

Survival Rates of Survivors of
Initial Myocardial Infarctions*

<u>Time From Discharge (years)</u>	<u>Cumulative Survival (percent)</u>
1	84%
2	77%
3	71%
4	65%
5	60%
6	56%
7	52%
8	47%

It is clear that a heart attack is associated with a considerable risk of post-discharge mortality. Therefore, to value the benefit of avoiding deaths due to heart attacks, we must include this increased risk of short-term future mortality as well.

* Data from Goldberg et al. (1979)

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We will first compute the total value of avoiding the subsequent mortality associated with the survivor of an initial heart attack who is then discharged from the hospital. If we assume a constant value per statistical life saved, we can discount the value of lives saved in future years back to the year of the initial heart attack at a 10 percent discount rate.

$$\text{This gives } PV = V [.16 + (.07)(.9) + (.06)(.81) + (.06)(.729) + (.05)(.656) + (.04)(.59) + (.04)(.53) + (.05)(.478)] = V[.417]$$

We must then subtract from this the present value of the average mortality risk for this age group, which is the value of avoiding the background risk of death. This gives $V [.07]$. The difference is the value of avoiding the excess risk of mortality due to an additional heart attack. This is the expected value of subsequent mortality avoided by preventing the initial non-fatal MI.

Since the value for fatal MI's and sudden death cases is just V , the weighted average value of avoided mortality per coronary case avoided, using \$1 million per life saved, is \$489,000 for people under 55 years old and \$513,000 for people over 55 years old.

Summary

Combining these calculations, the average value of avoiding a heart attack is \$59,750 for medical costs and foregone earnings, and \$497,000 for the value of avoiding the subsequent mortality risk, for a total of \$556,750.

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VALUE OF AVOIDING STROKES

Strokes are also a major factor in medical care expenses, reduced participation in the labor force, and increased mortality. Again, we have relied principally on Hartunian for many of our statistics. Hartunian estimated the direct cost of the medical care received by stroke victims in 1975. We have inflated these to 1983 dollars and adjusted them to reflect an OMB-required 10 percent real discount rate for calculating present values. The results for males aged 35-64 are shown on Table 3 for hemorrhagic and infarctive strokes, and for transient ischemic attacks (TIA).

Table 3

Medical Costs for Strokes, by Type
(in 1983 dollars)

<u>Males, by Age</u>	<u>Hemorrhagic</u>	<u>Infarctive</u>	<u>TIA</u>
35-44	12,600	17,600	3,184
45-54	13,300	18,100	3,184
55-64	17,200	23,600	3,184

Mortality is also a frequent outcome in stroke victims, as the following table taken from Hartunian's data indicates.

Table 4

Excess Probability of Dying After a Stroke, by Year and Type

<u>Hemorrhagic Stroke (males)</u>					
<u>Age</u>	<u>1st Year</u>	<u>2nd Year</u>	<u>3rd Year</u>	<u>4th Year</u>	<u>5th Year</u>
35-44	.60	.01	.01	.01	.01
45-54	.60	.01	.01	.01	.01
55-64	.59	.01	.02	.01	.01

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Infarctive Stroke (males)

<u>Age</u>					
35-44	.26	.04	.04	.04	.03
45-54	.26	.05	.04	.04	.04
55-64	.26	.05	.05	.04	.04

TIA (average for all ages of men)

<u>1st year</u>	<u>2nd year</u>	<u>3rd year</u>	<u>4th year</u>	<u>5th year</u>
.089	.003	.024	.011	-.002
<u>6th year</u>	<u>7th year</u>	<u>8th year</u>	<u>9th year</u>	<u>10th year</u>
.020	.015	.056	.003	.014

We valued a reduction in the risk of dying in each year at \$1 million per statistical life saved, and took the present value of the resulting amounts at a 10 percent real interest rate to obtain the following estimate of the value of reducing the mortality risk associated with strokes.

Table 5

Value of Avoided Mortality Risk
for Men by Age and Type of Stroke
(1983 dollars)

<u>Age</u>	<u>Hemorrhagic stroke</u>	<u>Infarctive Stroke</u>	<u>TIA</u>
35-44	630,000	380,000	171,000
45-54	630,000	390,000	171,000
55-64	630,000	410,000	171,000

Finally, we have again used Hartunian's estimates for foregone earnings, after adjusting for the OMB-required 10 percent discount rate and excluding that fraction of Hartunian's foregone earnings estimate that was associated with mortality. These results are on Table 6.

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Table 6

Foregone Earnings Per Male Stroke Victim
(1983 dollars)

<u>Age</u>	<u>Hemorrhagic Stroke</u>	<u>Infarctive Stroke</u>	<u>TIA</u>
35-44	41,000	71,000	1,114
45-54	26,000	43,000	3,076
55-64	11,000	14,000	8,280

The weighted average value of avoiding a stroke incident is shown below.

Table 7

Total Value for Men
(1983 dollars)

<u>Age</u>	<u>Mortality</u>	<u>Medical Expenses and Foregone Earnings</u>	<u>Total</u>
35-44	424,000	59,000	483,000
45-54	416,000	43,000	459,000
55-64	385,000	30,000	415,000

Other Factors Affecting Stroke Victims

We have been unable to estimate a value for avoiding the loss in quality of life that occurs in stroke victims. This is a significant omission. For example, of the people in the NHANES II who reported having had a stroke in the past, 45 percent suffered paralysis in the face and 13 percent still had at least partial facial paralysis, 54 percent suffered paralysis in at least one arm and 21 percent still had paralysis of the arm, 59 percent had numbness in arms or legs and 28 percent still had numbness, 30 percent had vision impairment and 13 percent still had vision impairment, and 50 percent had speech impairment with 22 percent still suffering from speech impairment. While we have no estimates of peoples willingness to pay to avoid the risk of these profound injuries, common sense suggest that it is high.

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THE COST OF HIGH BLOOD PRESSURE

Whether or not it leads to coronary or cerebrovascular disease, high blood pressure is a significant chronic illness. It also results in economic costs, including drugs, physicians' visits, hospitalization, and work loss. We used data from the NHANES II and from the National Institutes of Health to estimate the value of avoiding a case of high blood pressure. The NHANES II ascertained how many times per year a person saw a physician because of high blood pressure. The weighted average, for males between 40-59 years old with diastolic blood pressure over 90mm, was 3.27 visits per year.

The same population averaged 0.41 days per year when they were forced to remain in bed because of their high blood pressure, and 29 percent of them were on medication. The National Hospital Discharge Survey (1977) found that, excluding those with heart disease or cerebrovascular disease, people with high blood pressure used 4.6 percent of the occupied hospital days that year; this translates to an average of 3.8 percent of those with high blood pressure being hospitalized for 1 day each year. We have assumed that these results apply to the 40-59 year old age group as well.

Using these data, we estimated the value of avoiding a case of high blood pressure for one year. We assumed that medication costs \$200 per year, that hospitalization costs \$400 per day, and that physicians' visits for high blood pressure cost \$35 each. We have valued avoiding one day that a person is forced to remain in bed at the average daily wage - \$80. The expected

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value of avoiding a case of high blood pressure, exclusive of its impact on heart disease and strokes, is \$220. It should be noted that only 29 percent of the people with blood pressure above 90mm were on medication in part because some of them had not previously been detected as having high blood pressure. Therefore, average cost for a detected case will be higher. For example, Weinstein et al.,¹² used an average cost of \$200 in 1975 dollars or about \$450 in 1983 dollars, for treatment costs for patients undergoing medical care for hypertension. Nevertheless, we have used that \$220 figure to be conservative.

Deaths from Other Causes

The National Institute of Health also analyzed the Framingham data for deaths from all causes. Again, they found a significant relationship with blood pressure. These deaths include deaths other than from heart attacks and strokes, because high blood pressure is generally unhealthy condition. Blood pressure is a risk factor for other diseases, as well as, on its own. We used the logistic regression coefficients that were available for males 40-54, and subtracted the predicted deaths from heart attacks and strokes to avoid double counting. As with heart attacks and strokes, we did our simulations on the NHANES II sample because it represents the entire United States population. As before, these were valued at \$1 million per statistical life saved. And again, we prorated the deaths evenly among the years for lack of any evidence suggesting an uneven distribution.

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APPENDIX

Table 1

Regression of Diastolic Blood Pressure
in White Males Aged 40-59

<u>Variables</u>	<u>Coefficient</u>	<u>T-Statistic</u>	<u>Probability</u>
Age	0.2768	0.17	0.8636
Age2	-0.0014	0.10	0.9321
Body Mass Index	1.131	8.55	0.0001
Log(blood lead)	3.954	2.85	0.0080
Dietary Potassium	-0.0018	4.92	0.0001
Hemoglobin	1.548	3.90	0.0005
Albumin	3.587	2.50	0.0179
Log(dietary vitamin C)	1.838	4.65	0.0001

Table 2

Systolic Blood Pressure in
40-59 Year Old White Males

<u>Variables</u>	<u>Coefficient</u>	<u>T-Statistic</u>	<u>Probability</u>
Age	1.311	0.57	0.5720
Age2	-0.0068	0.30	0.7706
Body Mass Index	1.736	9.42	0.0001
Log(blood lead)	8.436	3.24	0.0028
Albumin	7.088	2.50	0.0178
Log(dietary Vitamin C)	2.411	3.84	0.0005
Log (dietary riboflavin)	-5.509	3.07	0.0044
Log(dietary oleicacid)	3.992	2.49	0.0183
Log(serum vitamin C)	-3.472	2.47	0.0184

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Table 3

Weighted Logistic Regression Probability
of Blood Pressure Greater Than or Equal
to 90 mm Hg Men aged 40-59

<u>Variable</u>	<u>Coefficient</u>	<u>T-Statistic</u>	<u>P-Valve</u>
Constant	-16.41	10.13	.0000
Log(Blood Lead)	0.693	3.96	.0000
Albumin	0.0873	3.70	.0001
Body Mass Index	1.700	9.34	.0000
Hemoglobin	0.0329	5.25	.0000
Log(Vitamin C)	0.3585	5.98	.0000
Dietary Potassium	-0.00058	7.47	.0000
Total Carbohydrates	0.00246	3.09	.0010

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