Value of a Life: What Difference Does It Make?[1]

John D. Graham[2] and James W. Vaupel[3]

Received August 28, 1980—Revised October 3, 1980

A comparison of the costs and benefits of 57 lifesaving programs reveals striking disparities across agencies and programs in cost/life saved and even greater disparities in cost/life-year saved. Within a broad range the monetary value assigned to the benefits of averting a death usually does not alter the policy implications of the analyses. The findings suggest that despite the substantial disagreements and uncertainties in the theory and practice of valuing lives, careful quantitative analysis can be helpful in setting health, safety, and environmental priorities.

KEY WORDS: value of a life; benefit-cost analysis; cost-effectiveness analysis; health, safety, and environmental policy.

Critics of benefit-cost analyses of lifesaving programs commonly dismiss such analyses with the query "but how can you put a dollar value on a life?" Some believe that it is "morally and intellectually deficient"(1) to attempt to monetize mortality. Other critics have observed that there are, at least currently, no generally agreed upon estimates of the so-called "value of a life" and consequently, as Nicholas Ashford of MIT has argued, "until society better understands this value, current analytic valuations of life must always be inadequate, and cannot be directly compared with the monetary costs or benefits of a regulation."(2)

That no consensus exists about how to express in dollars the benefits of averting deaths is certainly correct. Although the advocates of "willingness-to-pay" measures have gained the offensive against defenders of the "foregone earnings" (or "human capital") approach, the internecine battle here is by no means done.[4] Within the willingness-to-pay community, a subdued and often unacknowledged debate pits those who value lives against a smaller—but persuasive—group who value life-years; in a second debate, those psychologists and decision analysts who ask individuals their preferences question the methods of the economists who impute safety preferences as revealed by wage premiums for hazardous occupations. Surveys of expressed willingness-to-pay for small reductions in the probability of death have yielded values of a life from \$50 thousand to \$8 million (in 1978 dollars). (For the lower bound, see J.P. Acton;(3) for the upper bound, see M.W. Jones-Lee.(4)). Nine recent labor market studies of wage premiums have produced a narrower but still disparate range of values spread roughly evenly from \$300 thousand to \$3.5 million. For a review of these studies, see R. S. Smith.(5)

[1] The views expressed in this paper should not be attributed to the National Academy of Sciences or the Committee on Risk and Decision Making. Howard Raiffa and Joe Adamchic provided helpful comments on an early draft of this paper. Any errors, of course remain our responsiblity.

[2] Staff associate to the National Academy of Sciences' Committee on Risk and Decision Making, National Research Council, 2101 Constitution Avenue, N. W., Washington, DC 20418.

[3] Study Director of the Committee and Associate Professor of Policy Sciences and of Business Administration at Duke University.

[4] The "human capital" measure is based on estimates of the present value of foregone earnings due to premature death. The "willingness-to-pay" measure is derived from estimates of how much individuals are willing to pay to reduce their probability of death by a small amount.

In researching this article, we scrutinize some 35 studies of the costs and benefits of health, safety, and environmental programs. As might be expected given the disarray both among the theorists who attempt to define the value of a life and among the empiricists who attempt to measure it, the practitioners of these policy analyses differed considerably in how they valued lives. Of the 35 studies, 24 were benefit-cost analyses that explicitly assigned dollar values to lives saved, whereas 11 were cost-effectiveness analyses that estimated cost per life saved.[5] Of the 24 studies that valued lives, 15 used a foregone-earnings value, seven used a willingness-to-pay value, and two used values that were claimed to be consistent with both the foregone-earnings and the willingness-to-pay approaches. Five of these analyses used ranges of values; the other 20 picked point estimates—ranging from $55 thousand to $7 million.

In the seven studies that relied on willingness-to-pay estimates, the median value of a life was $625 thousand; in the 15 foregone-earnings studies, it was $217 thousand, only roughly a third as much.[6] At least to theorists this disparity may be unsettling, since the forgone-earnings approach has little theoretical support. Consequently, benefit-cost analyses based on foregone-earnings values may be undervaluing the benefits of lifesaving programs. Although fifteen studies used foregone-earnings values and only seven used willingness-to-pay values, an encouraging trend is that of the ten most recently published studies, half used a willingness-to-pay measure.

Given the uncertainties about how to define, let alone measure, the value of a life, it might be expected that the authors of the benefit-cost studies would calculate—and the reviewers and editors would demand—the most careful sensitivity analyses of how robust their conclusions were to alternative assumptions about the monetary value of life-saving. Just seven of the twenty-four benefit-cost studies, however, contain any sensitivity analysis at all, and only two studies identify the "switch-point" or "break-even" value that determines when a policy option should be favored over the contending alternative. Frequently, the estimates of mortality risks used in these studies are even more uncertain than the value of a life, making the absence of sensitivity analysis even more inexplicable—and inexcusable. Beyond this, most of the studies are afflicted with a variety of sins of omission and commission that we intend to detail in another paper. Even those who favor analysis in principle have to admit that analysis in practice is so devilishly demanding that the most diligent, intelligent, and well-intentioned practitioners often go astray.

Despite the resultant high level of noise, comparison of the 35 analyses of lifesaving programs does lead to some intriguing, if broadbrush, conclusions. To facilitate comparisons across studies, we calculated the "additional cost per additional life saved" of going from one policy option (usually, but not always, the status quo) to some alternative. Since some of the 35 studies considered several policy alternatives, we were able to compute a cost per life saved for 57 policy pairs. In each instance, we computed a net cost by subtracting from total costs any nonmortality benefits that the authors of the studies estimated: We made no attempt to correct for omitted costs or benefits. A number of analysts have cogently argued that since lives are never saved but merely prolonged, it is also informative to consider cost per life-year saved. Consequently, we estimated this figure for each of the 57 policy pairs as the quotient of the cost per life saved and the average life expectancy gained by individuals whose lives were saved.[7]

Table I summarizes the results. A number of interesting patterns and conclusions emerge.

First, for over a quarter of the policy pairs (13 of 57), the net costs are less than zero even when the benefits of saving lives are ignored. These lifesaving programs are justified by various morbidity and nonhealth gains alone: The mortality reductions achieved can be viewed as a generous bonus.

For many of the remaining policy pairs, the cost per life saved is low. Two judicious students of benefit-cost analysis have surveyed the theoretical and empirical literature to estimate a reasonable range for the value of a life: Martin Bailey's "low" estimate is $170 thousand and Robert S. Smith's plausible lower bound is $300 thousand.[(7)] For 59% (34 of 57) of the policies pairs in Table I the cost per life saved is under Bailey's $170 thousand and for 65% (37 of 57) it is less than or equal to Smith's $300 thousand. Thus, although benefit-cost analysis is sometimes criticized as being biased against health, safety, and

[5]All six of the studies done by the Council on Wage and Price Stablility were cost-effectiveness studies.

[6]The mean value of a life in the willingness-to-pay studies was $1,288 thousand; in the foregone-earnings studies it was $204 thousand.

[7]Let p_i be the proportion of those individuals whose lives would be saved who are age i and let e_i be the life expectancy of individuals age i. Then "average life expectancy gained" is given by the sum over all ages i of the product of p_i and e_i. We used life expectancy data for the U.S. population for 1976 as given in ref. (6).

Table I

Problem area	Agency concerned	Reference	Base case policy option	Alternative policy option	Net additional cost of alternative policy option: Per life saved	Per life-year saved
Highway Safety	NHTSA	(12)	Status quo	Mandatory air bags	$0	$0
Highway Safety	NHTSA	(14)	Status quo	Mandatory passive belts	0	0
Highway Safety	NHTSA	(16)	Status quo	Compulsory belt usage law	0	0
Highway Safety	NHTSA	(17)	Status quo prior to 55 mph limit	55 mph speed limit	0	0
Highway Safety	NHTSA	(18)	Status quo	Roadside hazard removal	0	0
Highway Safety	NHTSA	(18)	Status quo	Traffic enforcement	0	0
Highway Safety	NHTSA	(18)	Status quo	Vehicle inspection	0	0
Highway Safety	NHTSA	(39)	Voluntary motorcycle helmet usage	Compulsory helmet usage law	0	0
Genetic Screening	HHS	(19)	Status quo	Community screening program	0	0
Clothing	CPSC	(20)	no law	Clothing flammability law	0	0
Smoke Detectors	CPSC	(21)	Status quo	Mandatory smoke detectors	0	0
Stationary Source Air Pollution	EPA	(22)	Pre-1970 conditions	1970 Clean Air Act Standards	0	0
Stationary Source air Pollution[a]	EPA	(23)	Pre-1970 conditions	1970 Clean Air Act Standards	0	0
Highway Safety	NHTSA	(16)	Status quo	Mandatory passive belts	3,600	88
Highway Safety	NHTSA	(10)	Status quo	Mandatory air bags	13,000	538
Heart Disease Policy	HHS	(10)	Status quo	Mobile CHD unit	15,000	1,800
Highway Safety	NHTSA	(13)	Status quo	Active lap/ shoulder belts	21,000	516
Stationary Source Air Pollution	EPA	(26)	Pre-1970 conditions	1970 Clean Air Act Standards	30,000	2,300
Smoke Detectors	CPSC	(27)	Status quo	Mandatory, in sleeping rooms only	40,000	1,300
Highway Safety	NHTSA	(15)	Status quo	Mandatory passive belts	40,700	1,000
Highway Safety	NHTSA	(18)	Status quo	Emerging medical services program	41,000	1,000
Stationary Source Air Pollution	EPA	(25)	Pre-1970 conditions	1970 Clean Air Act	50,000	3,800
Highway Safety	NHTSA	(10)	Status quo prior to 55 mph limit	55 mph limit with full adherence	59,000	2,500
Furniture Fires	CPSC	(28)	Status quo	Mandatory smoke detectors	60,000	1,900
Highway Safety	NHTSA	(10)	Status quo prior to 55 mph limit	55 mph limit with partial adherence	64,000	1,900

Table I. Continued

Problem area	Agency concerned	Reference	Base case policy option	Alternative policy option	Net additional cost of alternative policy option: Per life saved	Per life-year saved
Highway Safety	NHTSA	(14)	Status quo	Mandatory air bags	78,000	1,900
Highway Safety	NHTSA	(18)	Status quo	Alcohol Safety Action Projects	81,500	2,000
Highway Safety	NHTSA	(16)	Status quo	Mandatory air bags	94,000	2,300
Highway Safety	NHTSA	(14)	No restraint	Active lap/ shoulder belt system	94,000	2,300
Heart Disease' Policy	HHS	(10)	Status quo	Diet program	102,000	6,500
Highway Safety	NHTSA	(30)	Status quo	Mandatory air bags	117,000	2,800
Saccharin	HHS	(31)	Status quo	Ban	136,000	8,500
Highway Safety	NHTSA	(10)	Mandatory air bags	Mandatory air bags plus 55 mph limit with full adherence	148,000	6,000
Highway Safety	NHTSA	(13)	No restraint	Mandatory air bags with active lap belts	162,000	4,000
Highway Safety	NHTSA	(29)	Pre-1966	1966 Motor Vehicle Safety Act	255,000	6,300
Highway Safety	NHTSA	(13)	Status quo	Mandatory air bags	300,000	7,300
Pertussis Vaccine[b]	HHS	(32)	Immunize	No program	300,000	4,200
Furniture Fires	CPSA	(28)	Mandatory smoke detectors	CPSC flamma-bility standard	400,000	12,900
Highway Safety	NHTSA	(15)	Status quo	Mandatory air bags	408,000	10,000
Highway Safety	NHTSA	(33)	65 mph limit	55 mph limit	500,000	12,000
Highway Safety	NHTSA	(34)	Unsafe fuel tank	Safer fuel tank	686,000	17,000
Smoke de-tectors	CPSC	(27)	Mandatory, in sleeping rooms only	Mandatory in all rooms	1,000,000	32,000
Highway Safety	NHTSA	(35)	Status quo prior to 55 mph speed limit	55 mph speed limit	1,200,000	29,000
Mobile source Air pollution	EPA	(36)	Pre-1970 conditions	1970 Clean Air Act	1,350,000	105,000
Highway Safety	NHTSA	(15)	Mandatory passive belts	Mandatory passive belts and air bags	1,400,000	34,000
Acrylonitrile	OSHA	(37)	Status quo	2.0 ppm	3,520,000	230,000
Carcinogens in water	EPA	(38)	150 mcl rule	100 mcl rule	3,800,000	240,000
Carcinogens in water	EPA	(38)	Status quo	150 mcl rule	3,900,000	240,000
Arsenic	OSHA	(40)	5 mcl rule	0.004 mcl rule	5,000,000	390,000
Carcinogens in water	EPA	(38)	100 mcl rule	50 mcl rule	6,300,000	390,000
Vinyl chloride	OSHA	(41)	50 ppm	1 ppm	7,500,000	490,000

Table I. Continued

Problem area	Agency concerned	Reference	Base case policy option	Alternative policy option	Net additional cost of alternative policy option	
					Per life saved	Per life-year saved
Benzene emissions	EPA	(42)	No control	97% control	7,600,000	480,000
Coke ovens	OSHA	(43)	Status quo	Proposed OSHA standard	12,100,000	790,000
Acrylonitrile	OSHA	(37)	2.0 ppm	1.0 ppm	28,800,000	1,900,000
Benzene emissions	EPA	(42)	97% control	99% control	51,000,000	3,200,000
Benzene	OSHA	c	10 ppm rule	1 ppm rule	102,000,000	6,600,000
Acrylonitrile	OSHA	(37)	1.0 ppm	0.2 ppm	169,200,000	11,000,000

[a]A report from the Council on Environmental Quality estimates incremental cost of stationary source cleanup at $7 billion.[(24)]
[b]"No program" is desirable at high values of a life because more deaths will be caused by reactions to a vaccine than will be prevented.
[c]The Supreme Court's Benzene Decision, Secretary of Labor vs. API (July 2, 1980). The Court cites Richard Wilson's work suggesting that the 1 ppm benzene standard would avert only two cancer deaths every six years. Ignoring capital costs and using OSHA's estimate of $34 million/yr in operating costs, it appears that the 1 ppm standard would cost $102 million per life saved.

environmental policy, for some three-fifths of the policy pairs examined benefit-cost analysis strongly supported lifesaving programs.

Professor Bailey's "high" estimate of the value of a life is $715 thousand, whereas Professor Smith's plausible upper bound is $3 million. In 16 cases, (28%), the cost per life saved exceeds Bailey's value and in 12 cases (21%) it exceeds Smith's. Thus, in roughly a quarter of the policy pairs we compared, the additional benefits of a lifesaving program would not appear, as least to a benefit-cost analyst, to be worth the additional costs.

That leaves relatively few cases in the middle. In only 7 cases (12%) does the cost per life saved fall within Bailey's range from $170 to $715 thousand, and similarly, in only 8 cases does it fall within Smith's order of magnitude range from $300 thousand to $3 million. Furthermore, in only 11 cases does the cost per life saved fall within the wide combined range from $170 thousand to $3 million.

This is an encouraging finding since it implies that the specific value of a life used in a benefit-cost analysis has not, in something like four-fifths or five-sixths of the cases, altered the policy implications of the study.[8] Given the confusion in the theory and practice of valuing lives, it is reassuring that precise estimates of the value of a life were usually not needed. In a prescient observation made prior to the recent spate of benefit-cost studies of lifesaving programs, Richard Zeckhauser[(8)] argued:

> ...there are conceptual and philosophical difficulties inherent in any procedure that attempts to attach a value of life, though conducting assessments with the aid of such procedures may nevertheless be helpful. In many circumstances policy choices may not change substantially if estimates of the value of life vary by a factor of ten. Getting a valuation that is accurate within a factor of three might be very useful.

Our results support Zeckhauser's optimism.

Beyond this, the results suggest that it is usually not necessary to explicitly value lives: Instead of a benefit-cost analysis, a cost-effectiveness analysis that calculates cost per life saved may often be sufficient. Given the controversy about assigning monetary values to the benefits of saving lives—and the distastefulness to many of doing so—it would seem to be judicious to rely on cost-effectiveness analysis to the extent possible.[9] Indeed, decision makers and other readers of these studies may be at least as interested in knowing that the cost per life saved by some program is $10 thousand—or $10 million—as in knowing that estimated net benefits amount to −$35 million or that the estimated benefit/cost ratio is 1.7.[10]

Table II cross-tabulates the 57 policy pairs in Table I by the agency concerned and by three ranges of cost per life saved. Since the studies we surveyed

[8]Of course, if a study considers a continuous range of alternatives rather than a few discrete alternatives, the value of a life will influence which policy is optimal.

[9]For further discussion of this, see Howard Raiffa, William Schwartz, and Milton Weinstein (9).

[10]In most cases, all three kinds of statistics should be presented to provide a variety of perspectives.

may not be representative and since they suffer from a myriad of empirical and theoretical flaws, implications should be drawn from Table II with caution. Nonetheless, the table does suggest that the costs of saving lives differ greatly across agencies or, at least, that the policy options being weighed by different agencies vary considerably in cost-effectiveness.

Another rough indication of interagency disparities is given by the median values of the cost per life saved for each agency's range of policy options. For the National Highway Traffic Safety Administration (NHTSA), the Department of Health and Human Services (HHS), and the Consumer Product Safety Commission (CPSC), the medians are comparable: $64 thousand, $102 thousand, and $50 thousand, respectively. For the Environmental Protection Agency (EPA), however, the median is $2.6 million...and for the Occupational Safety and Health Administration (OSHA) it is $12.1 million.

In addition to data on cost per life saved, Table I also presents estimates of cost per life-year saved. Those policies that are most cost-effective in saving lives also tend to be the policies that, by preventing accidents and acute diseases, save the lives of younger individuals. On the other hand, those policies that are least cost-effective in saving lives tend to be the policies that focus on preventing various kinds of cancer and chronic disease that largely afflict the elderly. For example, the victims of motor vehicle accidents lose, on average, 41 years of life expectancy, whereas the victims of cancer lose 16 years.[11] Consequently, measuring performance in cost per life-years saved does not substantially alter the rank order of the programs. Indeed, the Spearman rank correlation coefficient, for the 44 policy pairs with a positive value of cost per life saved, is 0.98. The debate between the advocates of cost per life-year saved versus cost per life saved thus may be more of theoretical interest than of operational significance, at least in setting priorities.

Measuring performance in cost per life-year saved does, however, further widen the large differences among the various types of life-saving programs. The *least* expensive OSHA program is 7 times more expensive per life-year saved that the *most* expensive NHTSA program; the median OSHA program is more than 400 times more expensive per life-year saved than the median NHTSA program. Again, these findings should not be taken as anything more than suggestive, since they are based on a crude comparison of a set of disparate studies. Furthermore, policymakers, for numerous legitimate reasons, may explicitly decide to devote more resources to saving lives in some areas than in others. For example, some causes of death are particularly painful and anxiety producing. To give another example, some causes of death may seem especially "unfair" since they result from largely involuntary exposure to, say, carcinogens in the air rather than from more voluntary factors such as cigarette smoking. The question, however, remains: How *much* more is it reasonable to spend in some areas than in others? Do the huge disparities in lifesaving expenditures reflect defensible judgments? To pose the question differently, could society, by shifting resources into more cost-effective lifesaving programs, save enough additional lives to justify such a shift?

The striking discrepancies across agencies and programs in cost per life saved, and the even greater discrepancies in cost per life-year saved, that our admittedly rough hewn study has uncovered suggest that more careful, larger scale efforts at comparing opportunities for saving lives may constructively contribute to the political process of setting health, safety, and environmental priorities. The confusion about the value of a life does not imply that thoughtful quantitative analysis cannot help us sort out our confusion about how best to save lives.

Table II. Breakdown of Policy Options by Agency and by Net Cost Per Life Saved

	Number of cases where net cost per life saved			
Agency	Under $170,000	Between $170,000 and $3,000,000	Above $3,000,000	TOTAL
NHTSA	22	7	0	29
HHS	4	1	0	5
CPSC	4	2	0	6
EPA	4	1	5	10
OSHA	0	0	7	7
TOTAL	34	11	12	57

[11] These life-expectancy statistics are based on the assumption that victims, if saved, would face the same life chances as nonvictims. Victims, however, may be frailer or more accident prone, on average, than nonvictims. By making some estimates about this, Richard Zeckhauser and Donald Shepard estimate an average life expectancy gain of 25 yrs, rather than 41 yrs, for victims of motor vehicle accidents. Also see ref. (11).

REFERENCES

1. M. S. Baram, *Regulation of Health, Safety, and Environmental Quality and the Use of Cost-Benefit Analysis*, Final report to the Administrative Conference of the United States (March 1, 1979), p. 27.

2. *Benefits of Environmental, Health, and Safety Regulation*, prepared for the Senate Government Affairs Committee, Center for Policy Alternatives, MIT (March 26, 1980), p. 19.
3. J. P. Acton, *Evaluating Public Programs to Save Lives: The Cost of Heart Attacks*, (Rand Corporation, Santa Monica, 1973).
4. M. W. Jones-Lee, *The Value of Life* (University of Chicago Press, Chicago, 1976).
5. R. S. Smith, Compensating wage differentials and public policy: A review, *Industrial and Labor Relations Review* **32**, 339—52 (1979).
6. *Monthly Vital Statistics Report* **26**, No. 11 (February 1978).
7. M. Bailey, *Reducing Risks to Life: Measurement of the Benefits* (American Enterprise Institute, Washington, D.C., 1980), pp. 52-66; R. S. Smith, *op. cit.*
8. R. Zeckhauser, Procedures for valuing lives, *Public Policy* **23**, No. 4, 419-464 (Fall 1975).
9. H. Raiffa, W. Schwartz, and M. Weinstein, "Evaluating Health Effects of Social Decision and Programs," in *EPA Decision Making* (National Academy of Sciences, Washington, D.C., 1978).
10. R. Zeckhauser and D. Shepard, Where now for saving lives, *Law and Contemporary Problems* **40**, No. 4 (Autumn 1976).
11. J. W. Vaupel, K. G. Manton, and E. Stallard, The impact of heterogeneity in individual frailty on the dynamics of mortality, *Demography* **16**, No. 3 (August 1979).
12. C. Y. Warner, M. R. Wither, and R. Peterson, "Societal Priorities in Occupant Crash Protection," *Fourth International Congress on Automotive Safety*, pp. 907-960 (July 1975).
13. H. P. Gates, Jr., "Review and Critique of NHTSA's Revised Restraint System Cost-Benefit Analysis," *Fourth International Congress on Automotive Safety*, pp. 209-233 (July 1975).
14. W. T. Coleman, Secretary of the Department of Transportation, "Benefit-Cost Analysis of Motor Vehicle Occupant Crash Protection," *Federal Register*, pp. 24078—24079 (June 14, 1976).
15. R. J. Arnould and H. Grabowski, "Auto Safety Regulation: An Analysis of Market Failure," *Bell Journal of Economics and Management Sciences*, in press.
16. Council on Wage and Price Stability, "Occupant Crash Protection Standard," Executive Office of the President, Washington, D.C., CWPS-244 pp. 1-24 (May 31, 1977).
17. C. T. Clotfelter and J. C. Hahn, Assessing the national 55 mph speed limit, *Policy Sciences* **9**, 281-294 (1978).
18. *National Highway Safety Needs Report*, (U.S. Department of Transportation, Washington, D.C., April 1976).
19. Swint, Shapiro, Corson, Reynolds, Thomas, and Kazazian, The economic returns to community and hospital screening programs for genetic disease, *Preventive Medicine* **8**, 463-470 (1979).
20. R. Dardis, S. Aaronson, and Ying-Nan Lin, Cost-benefit analysis of flammability standards, *American Journal of Agricultural Economics* 697-699 (November 1978).
21. T. E. Waterman, K. R. Minszewski, and D. G. Spadoni, *Cost-Benefit Analysis of Fire Detectors* (IIT Research Institute, Chicago, September 1978).
22. R. Koshal and M. Koshal, Environments and urban mortality—An econometric approach, *Environmental Pollution* **4**, 247-259 (1973).
23. T. D. Crocker, W. D. Schulze, S. Ben-David, and A. V. Kneese, *Methods Development for Assessing Air Pollution Control Benefits. Volume 1: Experiments in the Economics of Air Pollution Epidemiology*, prepared for EPA (February 1979).
24. Council on Environmental Quality, *Annual Report* (Washington, D.C., 1980).
25. A. M. Freeman III, *The Benefits of Air and Water Pollution Control: A Review and Synthesis of Recent Estimates*, prepared for the Council on Environmental Quality (December 1979).
26. L. B. Lave and E. Seskin, "The Benefits and Costs of Air Pollution Abatement," in *Air Pollution and Human Health, Resources for the Future* (Johns Hopkins University Press, Baltimore 1977), pp. 209-234.
27. J. M. Potter, M. L. Smith, and S. S. Lanwalker, *Cost-effectiveness of Residential Fire Detector Systems* (Texas Technical University, Lubbock, November 1976).
28. SRI, *Decision Analysis of Strategies for Reducing Upholstered Furniture Fire Losses*, (Department of Commerce, Washington, D.C., June 1979).
29. *Effectiveness, Benefits and Costs of Federal Safety Standards for Protection of Passenger Car Occupants* (General Accounting Office, Washington, D.C., July 1976).
30. L. S. Robertson, Car crashes: Perceived vulnerability and willingness to pay for crash protection, *Journal of Community Health* **3**, 136-141 (1977).
31. Council on Wage and Price Stability, "Council Urges More Study on Saccharin Ban," Executive Office of the President (June 15, 1977), pp. 1-16.
32. Koplan, Schoerbaum, Weinstein, and Fraser, Pertussis vaccine: An analysis of benefits, risks, and costs, *New England Journal of Medicine* **301** (October 1979).
33. G. Castle, The 55 mph limit: A cost-benefit analysis, *Traffic Engineering* 11-14 (January 1976).
34. Ford Motor Company, "Benefits and Costs Related to Fuel Leakage Associated with the Static Rollover Test Portion of FMVSS 208," reprinted in the *Chicago Tribune* Section 1, p. 1 (October 14, 1979).
35. C. A. Lave, "Energy Policy as Public Policy," in *Changing Energy Use Futures, Volume IV*, Fazzolare and Smith, eds., International Conference on Energy Use Management (October 22-26, 1979), pp. 2046—2053.
36. National Academy of Sciences, *Air Quality and Automobile Emission Control*, Vol. 4, "The Costs and Benefits of Automobile Emission Control," prepared for U.S. Senate Committee on Public Works, (September 1974), pp. 1-471.
37. Council on Wage and Price Stability, "Council Comments on Proposed Standard for Occupational Exposure to Acrylonitrile," Executive Office of the President (May 22, 1978).
38. Council on Wage and Price Stability, "Comments Submitted to the EPA on the Proposed Drinking Water Regulations," Executive Office of the President, Washington, D.C. (September 5, 1978).
39. A. Muller, Evaluation of the costs and benefits of motorcycle helmet law, *American Journal of Public Health* **70**, 586-592 (June 1980).
40. Council on Wage and Price Stability, "Council Comments on OSHA's Proposed Standard on Arsenic," Executive Office of the President (September 14, 1976).
41. C. Perry and R. Outlaw, "Safe and Healthful Working Conditions—The Vinyl Chloride Experience," Philadelphia, University of Pennsylvania (1978).
42. A. Nichols, "Alternative Regulatory Strategies for Controlling Benzene Emissions from Malcic Anhydride Plants," paper for the Environmental Protection Agency (March 1980).
43. Council on Wage and Price Stability, "Exposure to Coke Oven Emissions: Proposed Standard," Executive Office of the President (May 11, 1976).