from: Program Budgeting and Benefit-Cost Analysis by Harley H. Hinrichs and Graeme M. Taylor

CASE

7

DISEASE CONTROL PROGRAMS

BENEFIT-COST ANALYSIS OF PROGRAMS TO ENCOURAGE THE USE OF PROTECTIVE DEVICES BY MOTORCYCLISTS

In February, 1967, Mr. Harley Davidson, an analyst in the office of the Injury Control Program, Public Health Service (Department of Health, Education and Welfare) was reviewing DHEW's recently published Program Analysis 1966-1 titled *Disease Control Programs—Motor Vehicle Injury Prevention Program*. Mr. Davidson was a member of a task force established in DHEW to evaluate a series of benefit-cost analyses of various proposed disease control programs. In addition to motor vehicle injury prevention benefit-cost studies had been made of programs dealing with control of arthritis, cancer, tuberculosis and syphilis. Mr. Davidson's specific responsibility was to review Program Unit No. 8 of the motor vehicle injury prevention program, *Increase Use of Improved Safety Devices by Motorcyclists,* in order to (a) evaluate the methodology and results of the benefit-cost analysis of Program Unit No. 8, and (b) recommend whether or not the analysis justified the level of funding contemplated in that program unit.

This case was prepared with the cooperation of the United States Department of Health, Education and Welfare by Graeme M. Taylor under the supervision of Charles Christenson, Associate Professor of Business Administration, Harvard University, on behalf of the Bureau of Training, United States Civil Service Commission. The case is intended for class discussion only, and certain names and facts may have been changed which, while avoiding the disclosure of confidential information, do not materially lessen the value of the case for educational purposes. This case is not intended to represent either effective or ineffective handling of an administrative situation, nor does it purport to be a statement of policy by the agency involved.

THE MOTORCYCLE PROGRAM UNIT

The following is the description of Program Unit No. 8 which appeared in Program Analysis 1966-1

Program Description—Increase Use of Improved Safety Devices by Motorcyclists

To prevent accidental deaths due to head injuries of motorcycle riders through appropriate public health activity at the National, State and local levels.

Approach

The Public Health Service approach to solving the motorcycle injury problem will involve four phases. Although each of the four phases of activity is identified separately, all will be closely coordinated and carried out simultaneously. The four phases of activity are:

1. A National education program on use of protective head gear aimed primarily at motorcycle users. It will also include efforts to prepare operators of other motor vehicles to share the road with motorcycles.

(millions of dollars)

	1968	1969	1970	1971	1972
Estimated Program Level	$1.679	$1.609	$1.575	$1.569	$1.567

2. A cooperative program with other National organizations and the motorcycle scooter industry to improve protective and safety devices.

3. Involvement of State and local health departments and medical organizations in programs and activities designed to minimize accidental injury in motorcycle accidents.

4. Conduct surveillance activity on appropriate aspects of the motorcycle accident and injury problem.

The program unit was estimated to require the above level of new funding during the 5-year planning period 1968–72:

Exhibit 1 gives a summary of the way in which the proposed funds would be spent.

The benefit-cost study estimated that the above program would result in the saving of 4,006 lives over the five-year period 1968–1972 (no reduction in injuries was considered). The cost of

the program discounted at 4 per cent was $7,419,000; the benefits of the program, based on the lifetime earnings discounted at 3 per cent of those whose deaths would be averted, were estimated at $512,754,000.[1] Hence, the benefit-cost ratio equalled 69.1:1. Another measure of program effectiveness was the cost per death averted, $1,860. Exhibit 2 summarizes the benefit-cost ratios and the costs per death averted for all nine motor vehicle injury prevention program units and for the arthritis, cancer, tuberculosis, and syphilis programs. Exhibit 3 presents, for all programs, the estimated five-year reduction in numbers of injuries and deaths and the estimated discounted five-year program dollar costs and benefits.

OVERALL METHODOLOGY OF THE BENEFIT-COST STUDIES

In describing the methodology used in the benefit-cost studies of the Motor Vehicle Injury Prevention Program, Program Analysis 1966-1 stated explicitly the constraints under which the analyses were performed.

Any methodology sets the parameters on how a problem will be managed and which of several possibly germane problem elements will receive attention. Consequently, much of this report deals with the mapping of boundaries. However, when presented under the guise of method, much of this limit-setting is implicit since attention is on the method of problem-solving rather than on the limits being placed on problem-solving by the method.

In this effort to apply benefit-cost analysis to the domain of vehicular accidents, three major constraints were laid down. These constraints influence the entire analysis and warrant explicit attention.

1. The problem of motor vehicle accidents is examined exclusively in terms of public health concerns. This mandate focused on the role of human factors in vehicular accidents and the amelioration of injury caused by vehicular accidents. In adopting this posture, three major factors in the vehicular accident complex—law enforcement, road design and traffic engineering—were, for the most part, excluded. This constraint had the effect of limiting the problem to considerations traditionally within the purview of DHEW, while excluding those elements which are traditionally handled by the Department of Commerce and other Government agencies.

2. The problem of motor vehicle accidents is handled by nine programs which, in the opinion of Committee members, were feasible and realistic. Criteria for determining "feasible and realistic" were not made explicit. However, program proposals which were rejected, such as no person under 21 being allowed to drive, reduction of maximum speeds on all roads by 20 percent, the Federal Government paying for the installation of $100 worth of safety devices on all automobiles, indicate the cultural values and assumed cost factors which were two issues involved in judging "feasible and realistic." In Appendix D, "Lifting Constraints," the constraint of a program's being "feasible and realistic" was lifted and three potential program proposals, which were initially discarded because of this constraint, were examined.

3. The problem of motor vehicle accidents is handled by programs based on what is known today. This constraint ruled out dependence on new findings based on future research. Unlike the other constraints, this ruling, in the minds of the Committee members, constituted a basic condition for undertaking a benefit-cost analysis of alternative program strategies. Unless the analysis was restricted to "what is known," the "need for more research would allow one partner in the dialogue to withdraw from the struggle without even having been engaged."

The report then went on to describe the rationale behind benefit-cost analysis.

The next step was to explore this area from two perspectives: (a) current program status and its apparent effect on the problem; (b) anticipated outcomes if the Federal Government does not increase its program effort beyond its present level.

The reasoning behind benefit-cost analysis is quite straightforward. The idea is to allow for a meaningful comparison of the change which results in a given situation as a result of applying alternative programs. In order to bring about this state of affairs, a measurable common denominator is useful for rating program outcome and program costs. This common denominator is dollars. Granting the existence of the common denominator, there must, in addition, be a point on which to take a "fix" in order to support the contention that change has, in fact, taken place. This point for fixing position and shifts in relation to change wrought by program is the baseline.

In this exercise the baseline was created by assessing past rates for motor vehicle and pedestrian deaths and injuries. The assumption was made that the current level of program effort in DHEW would remain constant through 1972 with the exception of increases for obligated administrative costs. The observed trend was then projected and applied to the anticipated population distribution for the years 1967–1972. Program costs and savings due to the introduction of the program were limited to the five-year period 1968–1972, although certain programs were just gathering momentum by the end of this period. . . . The required common denominator was incorporated into the baseline by converting fatalities into lost earnings and by translating lost work days, bed disability days, length of hospitalization, physician visits, and other medical services resulting from injuries into the direct and indirect costs represented by these statistical measures. . . . Throughout this analysis, the total dollar costs and benefit for the 5-year period are discounted to 1968, the base year, to convert the stream of costs and benefits into its worth in the base year . . .

With the baseline and common denominator established, the Committee was able to examine the potential payoff for a variety of program units even though these units differed with respect to such factors as cost of implementation, target group to be reached, method to be employed, and facet of the total program addressed by the proposed program.

With the establishment of the baseline and the development of techniques to convert all elements of the equation to a common denominator, the energies of the Committee were given over to the creation of program units. There are a number of variables which may contribute to the occurrence of a vehicular accident and its resultant injury or death. The skill of the driver, the condition of the road, the speed of the vehicle, the condition of the car, the failure to have or to use safety devices incorporated in the car are just a few of many that are mentioned in the literature. What we know about vehicular accidents is expressed in terms of these variables and as a consequence, program formulations are generally placed in the context of managing these variables, either singly or in combination. A program unit, as

[1] Appendix H discusses the selection of the discount rates as well as the methodology used in determining lifetime earnings.

TABLE 1

HISTORICAL DATA ON MOTORCYCLE REGISTRATIONS AND FATALITIES

Year	Total Number of Registered Motorcycles in the U.S.	Number of Deaths from Motorcycle Accidents	Rate of Deaths per 100,000 Motorcycles
1959	565,352	752	133.0
1960	569,691	730	128.1
1961	595,669	697	117.0
1962	660,400	759	114.9
1963	786,318	882	112.2
1964	984,760	1,118	113.5

developed by the Committee, usually addressed a single variable.

The nine program units created by the Committee are briefly described in Appendix I.

There are two links needed to effect the benefit-cost analysis in vehicular accidents. The first link is associated with the estimate of reduction that could be realized if a given variable were addressed by a program of some sort. This link is supplied in vehicular accidents by the expertise of the Committee members and recourse to studies on the particular variable in question. The second link is associated with the effectiveness of the program proposed to bring about the estimated reduction. In vehicular accidents this is supplied by the experience with programs of the Committee members and the success in the past of programs, similar in content, devoted to public health problems. . . . Three assumptions must be made in working with the program units at this time:

1. Each program unit is independent. In combination with other program units the estimated impact will neither increase nor decrease.

2. Unless specified, a program unit will have an impact on the total target population, and its benefits, i.e., a reduction of fatality and injury, will be distributed in proportion to the occurrence of fatality and injury by age grouping among the baseline population. For example, if one percent of fatalities occur in the under-one-year-old age group, then one percent of the estimated reduction in fatality due to any program unit will be assigned to the under-one age group for the computation of benefits to the economy of the program unit.

3. Unless specified, the distribution of estimated injury benefits will be the same as with the fatality benefits. In addition, it is assumed that the reduction of injury estimates covers proportionally the same range of severity as is represented in the base-line figures.

ESTIMATE OF BENEFITS OF THE MOTORCYCLE PROGRAM

As indicated in the previous section, the benefit-cost studies of the motor vehicle injury prevention programs began with a stipulation of a baseline, or the number of deaths and injuries to be expected if the level of DHEW effort remained constant. Next, an estimate was made of the number of deaths and injuries which would be avoided if the proposed program unit were adopted. Finally, the reduction in deaths and injuries was translated into dollar terms. These three steps will now be described in further detail as they applied to Program Unit No. 8.

Baseline

The team working on the motorcycle unit had available the information given in [Table 1 on page 244].

The team estimated that (1) the number of registered motorcycles would continue to increase at an increasing rate, and (2) the death rate would decline in the absence of new safety programs to a level of 110 deaths per 100,000 registered motorcycles. Accordingly, the number of motorcycle accident deaths to be expected without the safety program was projected as shown in the following table:

TABLE 2

PROJECTED BASELINE CASE

Year	Projected Total Number of Registered Motorcycles in the U.S.	Projected Number of Deaths from Motorcycle Accidents without Program (based on 110 deaths per 100,000 registered motorcycles)
1968	2,900,000	3,190
1969	3,500,000	3,850
1970	4,200,000	4,620
1971	5,000,000	5,500
1972	6,000,000	6,600

Effectiveness of the program unit

Calculation of the anticipated reduction in the number of deaths resulting from the proposed program unit involved two separate estimates: (1) the effectiveness of the program in persuading motorcyclists to wear helmets and protective eyeshields; and (2) the effectiveness of these devices in reducing deaths (injuries were not considered in the analysis of this program unit). The team's judgment was that the program would result in use of helmets and eyeshields to the degree shown in [Table 3 on page 246].

Regarding the second factor, the effectiveness of protective devices in reducing deaths, the team relied on a study entitled "Effect of Compulsory Safety Helmets on Motorcycle Accident Fatalities" which appeared in *Australian Road Research*, Vol. 2, No. 1, September, 1964. This study reported that the number of motorcycle fatalities occurring in the Australian state of Victoria in the two years following the effective date of a law requiring the wearing of helmets was only 31 while the number of fatalities projected on the basis of the experience of the two preceding years was 62.5,

TABLE 3

ESTIMATED EFFECTIVENESS OF PROGRAM IN ENCOURAGING PROTECTIVE DEVICES

Year	Estimated Percentage of Motorcyclists Using Helmets and Eyeshields
1968	20%
1969	30%
1970	40%
1971	50%
1972	55%

for a reduction of about 50 per cent. Other states, which did not have such a law, had shown a reduction of about 12 per cent in the same period, a difference of 38 per cent. The committee concluded that 100 per cent usage of helmets and eyeshields by American motorcyclists would reduce the number of deaths by about 40 per cent.

Multiplication of the figures for projected usage of protective devices given in Table 3 by 40 per cent gave the estimated percentage reduction in deaths, and application of these percentages to the baseline data of Table 2 gave the estimated reduction in number of deaths. The results are summarized below.

Conversion to economic benefits

For the purpose of calculating the lifetime earnings lost in the event of a motorcycle fatality, it was necessary to estimate the distribution of fatalities by age and sex. In 1964 approximately 90 per cent of the victims of motorcycle accidents had been male and 10 per cent female; similarly, about 90 per cent had been in the age group 15–24 and 10 per cent in the age group 25–34. The data were not cross-classified, so it was considered necessary to assume that the sex distribution of fatalities in each age group was the same as the overall distribution, i.e., 90:10. Projecting these percentages into the future, it was calculated that of the 255 fatalities which the proposed program was expected to avoid in 1968, 207 would be males between 15 and 24 inclusive (i.e., .9 x .9 x 255). Combining this procedure for all categories and years resulted in the following estimates [in Table 5 on page 247] of the distribution of death reductions over the 5-year period.

The final step in calculating the expected benefits of the proposed program was to assign the appropriate dollar benefits to the above estimates of decreases in deaths by age group and sex. This was done by multiplying the decrease in deaths in each sex-age group "cell" in the above table by the applicable discounted lifetime earnings figure for that particular cell.

Table 6 shows lifetime earnings by age and sex, discounted at 3 per cent, used in computing the dollar benefits of reducing motorcycle accident fatalities.

The methodology used in deriving the figures in the table below is described in Appendix II.

The number of deaths saved in each cell of Table 5 was multiplied by the appropriate earnings figure from Table 6 and discounted at 3 per cent to the base year, 1968. For example, Table 5 indicates that it was estimated that in 1968 the lives of 3 females between the ages of 25 and 34 would be saved. The discounted lifetime earnings of females in this age group was found from Table 6 by averaging the discounted lifetime earnings for females 25–29 and 30–34, the average of $81,702 and $77,888 being $79,795. This was multiplied by 3 to give $239,385; using a present value factor of 1 (since 1968 was the base year), the figure derived was $239,385. Similarly, discounted

TABLE 4

ESTIMATED REDUCTION IN DEATHS FROM PROPOSED PROGRAM

Year	Projected Number of Deaths from Motorcycle Accidents without Program	Estimated Percentage Reduction in Deaths with Program	Estimated Reduction in Number of Deaths with Program
1968	3,190	8%	255
1969	3,850	12%	462
1970	4,620	16%	739
1971	5,500	20%	1,100
1972	6,600	22%	1,450
5-year total	23,760	—	4,006

TABLE 5

ESTIMATED REDUCTION IN DEATHS BY AGE AND SEX

Year	Death Reduction				
	Age 15–24		Age 25–34		
	Males	Females	Males	Females	Total
1968	207	23	22	3	255
1969	374	42	41	5	462
1970	598	67	67	7	739
1971	891	99	99	11	1,100
1972	1,174	131	130	15	1,450
Total	3,244	362	359	41	4,006

TABLE 6

DISCOUNTED LIFETIME EARNINGS BY AGE AND SEX

Age	Males	Females
Under 1	$ 84,371	$50,842
1–4	98,986	54,636
5–9	105,836	63,494
10–14	122,933	73,719
15–19	139,729	81,929
20–24	150,536	84,152
25–29	150,512	81,702
30–34	141,356	77,888

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figures were obtained for each year by age group and sex; the results are shown below in Table 7.

Thus, over the five-year program period, 1968–1972, it was estimated that 4,006 deaths could be averted (Table 5), at a present-value cost of $7,419,000 (Exhibit 1). The present value of the lifetime earnings of the 4,006 persons whose lives would be saved during this period was shown in Table 7 to be $512,754,000.

These data were summarized in the form of two measures of program effectiveness:

(1) *Program Cost per Death Averted*

$$= \frac{\$7{,}419{,}000}{4{,}006} = \$1{,}860$$

(2) *Benefit/Cost Ratio*

$$= \frac{\$512{,}754{,}000}{\$7{,}419{,}000} = 69.1$$

As noted earlier, Exhibits 2 and 3 summarize the results for all nine motor vehicle program units and also for the eight other disease control programs studied.

QUESTIONS

1. As Mr. Davidson, prepare a critique of the methodology and findings of the benefit-cost analysis of Program Unit No. 8.

2. Based on your evaluation of the analysis, would you recommend the level of funding proposed?

TABLE 7

DISCOUNTED SAVINGS RESULTING FROM PROGRAM TO PROMOTE USE OF PROTECTIVE DEVICES BY MOTORCYCLISTS (000's)

Year	Total	Age 15–24		Age 25–34	
		Males	Females	Males	Females
TOTAL	$512,754	$434,002	$27,164	$48,714	$2,874
1968	36,140	30,347	1,976	3,578	239
1969	61,972	52,423	3,282	5,895	372
1970	97,152	82,363	5,059	9,248	482
1971	39,547	117,928	7,408	13,393	818
1972	177,943	150,941	9,439	16,600	963

EXHIBIT 1

DISEASE CONTROL PROGRAMS

Proposed Budget for Program to Increase Use of Protective Devices by Motorcyclists, 1968–1972 (costs in thousands)

	1968	1969	1970	1971	1972
Total Number of Persons	42	42	42	42	42
Total Costs	$1,679	$1,609	$1,575	$1,569	$1,569
Personnel	504	504	504	504	504
Program	1,175	1,105	1,070	1,065	1,065
Staff					
Central Office	13	13	13	13	13
Regional Office	9	9	9	9	9
State Assignees	20	20	20	20	20
Personnel	$ 504	$ 504	$ 504	$ 504	$ 504
Evaluation & Surveillance	300	300	300	300	300
State Projects [1]	500	500	500	500	500
National TV Spots	60	60	60	60	60
Educational TV Series	100	100	100	100	100
Safety Films	40	40	20	20	20
Publications	100	30	30	30	30
Exhibits	30	30	15	15	15
Community Projects	25	25	25	25	25
Campus Projects	20	20	20	15	15

[1] Ten projects at $50,000 per project.

EXHIBIT 2

DISEASE CONTROL PROGRAMS

Costs per Death Averted and Benefit/Cost Ratios for All Program Units Studied

Program	Program Cost per Death Averted	Benefit/Cost Ratio
Motor Vehicle Injury Prevention Programs		
Increase seat belt use	87	1,351.4:1
Use of improved restraint devices	100	1,117.1:1
Reduce pedestrian injury	600	144.3:1
Increase use of protective devices by motorcyclists	1,860	69.1:1
Improve driving environment	2,330	49.4:1
Reduce driver drinking	5,330	21.5:1
Improve driver licensing	13,800	3.8:1
Improve emergency medical services	45,000	2.4:1
Improve driver training	88,000	1.7:1
Other Disease Control Programs Studied		
Arthritis	N/A	42.5:1
Syphilis	22,252	16.7:1
Uterine Cervix Cancer	3,470	9.0:1
Lung Cancer	6,400	5.7:1
Breast Cancer	7,663	4.5:1
Tuberculosis	22,807	4.4:1
Head and Neck Cancer	29,100	1.1:1
Colon-Rectum Cancer	42,944	0.5:1

EXHIBIT 3

DISEASE CONTROL PROGRAMS

Reduction in Injuries and Deaths and Total Discounted Program Costs and Savings for All Program Units Studied, 1968–1972

Program Unit	Discounted Program Costs ($000's)	Discounted Program Savings ($000's)	Reduction in Injuries	Reduction in Deaths
Motor Vehicle Injury Prevention Programs				
Seat belts	2,019	2,728,374	1,904,000	22,930
Restraint devices	610	681,452	471,600	5,811
Pedestrian injury	1,061	153,110	142,700	1,650
Motorcyclists	7,419	512,754	——	4,006
Driving environment	28,545	1,409,891	1,015,500	12,250
Driver drinking	28,545	612,970	440,630	5,340
Driver licensing	6,113	22,938	23,200	442
Emergency medical services	721,478 [1]	1,726,000	[2]	16,000
Driver training	750,550	1,287,022	665,300	8,515
Other Disease Control Programs Studied				
Arthritis	35,000	1,489,000	N/A	N/A
Syphilis	179,300 [3]	2,993,000	N/A	11,590
Uterine Cervix Cancer	118,100 [3]	1,071,000	N/A	34,200
Lung Cancer	47,000 [3]	268,000	N/A	7,000
Breast Cancer	22,400	101,000	N/A	2,396
Tuberculosis	130,000	573,000	N/A	5,700
Head & Neck Cancer	7,800	9,000	N/A	268
Colon-Rectum Cancer	7,300	4,000	N/A	170

[1] Includes $300 million State matching funds.
[2] This program does not reduce injury; however, it is estimated to reduce hospital bed days by 2,401,000 and work loss days by 8,180,000.
[3] Funding shown used as basis for analysis—includes funds estimated to come from sources other than DHEW.

APPENDIX I

DISEASE CONTROL PROGRAMS

Brief Description of the Nine Motor Vehicle Injury Prevention Program Units

Program Unit 1—Improve Driver Licensing

This program will develop a selective licensing procedure in each State which will screen out the drivers unsafe because of medical conditions. In addition, the program's approach will help drivers with impairments through medical care, education, special devices, etc., so that they can continue to drive with reasonable safety.

Program Unit 2—Improve Driver Performance and Behavior by Upgrading Driving Skills, Knowledge and Attitude (Improve Driver Training)

An improved program of driver education and training, through classroom work on roads, cars, laws, and personal limitations and behind the wheel supervised driving experience, will help prevent accidental deaths and injuries. This program is aimed at the new driver. A program for retraining the experienced driver was considered to hold potential, but was not included.

Program Unit 3—Improve Driving Performance and Behavior by Decreasing Driving Exposure While Under the Influence of Alcohol and Drugs (Reduce Driver Drinking)

This program will include a National education program to inform school age children and adults about the effects of alcohol on body functions and driving, how it increases risk of accident, and how social drinking can be arranged so that the driving risk is significantly lowered.

Treatment and rehabilitation services for the chronic alcoholic will be supported as well as strict enforcement of the laws involving drivers with blood alcohol levels exceeding .10 percent.

Program Unit 4—Reduce the Exposure of Pedestrians to Injury (Reduce Pedestrian Injury)

A National education program will inform elderly persons of personal limitations, i.e., declining vision, and will inform the elderly and young children about traffic control devices, laws and characteristics of the modern automobile and motor vehicle traffic.

Program Unit 5—Increase Seat Belt Use

A National public education program will use all mass media and organizational approaches to inform individuals about the decrease in risk and other advantages involved in wearing seat belts at all times. Opinion leaders such as clergy and the medical and legal professions will be utilized in transmitting the information.

Program Unit 6—Improve Driving Environment

A National education program will inform the general public about the desirability of changes in vehicle and road design, provide them with an understanding of their relationships to safer driving and create a readiness to accept instruction in their proper use.

Program Unit 7—Develop and Encourage Use of Improved Restraint Systems for Children and Adults (Use of Improved Restraint Systems)

Information on the development of restraining devices will be made available to manufacturers and others who can stimulate the production of the devices. A National public education program will use all mass media and organizational approaches, including opinion leaders, to inform individuals about the decrease in risk and other advantages of using the improved restraining systems at all times.

Program Unit 8—Increase Use of Helmets and Protective Eye Shields by Motorcyclists

Appropriate public health activity at all levels will prevent accidental deaths due to head injuries of motorcycle riders. A National education program includes the use of protective head gear and prepares operators of other motor vehicles to share the road with motorcycles. Other activities consist of a cooperative program with other National organizations and the motorcycle scooter industry to improve protective and safety devices and the involvement of State and local health departments and medical organizations in programs designed to minimize accidental injury in motorcycle accidents.

Program Unit 9—Improve Emergency Medical Services

In order to assure adequate and timely care for every injured person, a planned approach must link the community ambulance services and hospitals into an integrated system which includes: (1) the setting and maintenance of standards; (2) a communication system permitting early accident detection and rapid dispatch of services; (3) a training program for managing all patients; (4) public education on first aid; and (5) research on better emergency care techniques.

Strategic pilot projects should be established in selected communities and should include all elements of a total transportation program—land, air, and sea.

An extensive program of remodeling of emergency departments in hospitals is required to redesign, equip and staff them adequately. Mobile emergency treatment stations (Packaged Emergency Station—PES) dispatched from the hospital to distant points of expected needs is suggested for extending hospital capacity.

APPENDIX II

DISEASE CONTROL PROGRAMS

Some Methodological Problems

This appendix discusses briefly the procedures used (1) to determine the lifetime earning patterns of persons whose deaths might be averted by a disease control program, and (2) to decide on appropriate discount rates to use in reducing future benefits and costs to their present values.

Lifetime Earnings Patterns

The calculation of lifetime earnings figures used in DHEW'S 1966 series of disease control program analyses was based largely on methodology developed by Mrs. Dorothy P. Rice of the Office of Research and Statistics, Social Security Administration, and reported by her in *Estimating the Cost of Illness.*[1]

The appropriate measure of output loss for individuals was considered to be year-round, full-time earnings, including wages and salaries before deductions plus wage supplements such as employer contributions for social insurance and private pension and welfare funds. Unpublished mean earnings data for full-time male workers in 1964 by 5-year age intervals were furnished by the Bureau of the Census. Similar data were not available for females, but the Bureau of the Census published *median* incomes for year-round full-time workers by sex and age. For each age class, it was assumed that the ratio of female to male *mean* income was the same as the ratio of female to male *median* income.

Each mean earnings figure was adjusted upwards to take account of wage supplements by a factor of 1.08268, derived from data published by the Department of Commerce in *Survey of Current Business.*

Although a relatively high proportion of females are housewives and not in the labor market, it was considered desirable to impute a value to their services. For this purpose the 1964 mean earnings of domestic servants, or $2,767, was used. It was recognized that the imputed value was "clearly on the low side," for it made no allowance for the housewife's longer work week and took no account of the size of the household cared for.

The following table presents 1964 mean earnings by age class, adjusted for wage supplements and including an imputed value for housewives' services.

Although Table A presents only cross-sectional data for a single year, 1964, it was assumed that it could also be used to represent the earnings pattern of an average individual over his working lifetime. In other words, an average 20 year-old male in the labor force could expect to earn $4,634 on the average for full-time work over the next five years, $6,373 for the five years after that, and so forth. It was recognized that this assumption might result in a downward bias in the estimate of discounted lifetime earnings because other data indicated that younger workers appeared to benefit more from economic growth than older workers. The evidence for this bias was considered inconclusive, however.

In converting the estimated mean earnings by year into lifetime earnings, several other factors had to be considered.

First, not everyone would have been working or productive had death from the cause under study not interfered. Some victims of fatal accidents would have been too old or too young or unwilling or unable to find a job. For the purpose of the disease control program analyses, it was assumed that if it were not for these illnesses or causes of death, persons stricken would have had the same employment experience as persons in the same age and sex groups. Accordingly, the 1964 labor force participation rates (proportion of all civilians who were employed or looking for a job) were applied and further adjustments were made for the number who would have been employed under conditions of full employment, defined as 4-percent unemployment. The unemployment rates for 1965 were used because 1965 was the most current year of full employment. Without the assumption of full employment, losses due to mortality and disability could not have been isolated from losses due to unemployment.

Table B [page 254] presents the data used for these adjustments.

TABLE A

ADJUSTED MEAN EARNINGS BY AGE AND SEX, 1964

Age Group	Male	Female
14–19	$2,829	$3,387
20–24	4,634	3,800
25–29	6,373	3,951
30–34	7,532	4,670
35–39	7,953	4,390
40–44	8,305	4,584
45–49	8,229	4,724
50–54	7,435	4,268
55–59	7,174	4,355
60–64	7,113	4,318
65–69	5,981	3,851
70 and over	5,887	3,790

[1] Health Economics Series No. 6, Public Health Service Publication No. 947-6, May 1966.

TABLE B

LABOR FORCE PARTICIPATION AND UNEMPLOYMENT RATES BY AGE CLASS

Age Group	1964 Labor Force Participation Rates		1965 Unemployment Rates	
	Male	Female	Male	Female
14	17.7	9.9	6.8	5.2
15–19	44.8	31.9	13.7	14.8
20–24	85.6	49.1	6.3	7.3
25–29	94.7	37.9	3.3	5.7
30–34	96.4	36.2	2.6	5.2
35–39	95.8	41.7	2.6	4.8
40–44	95.4	47.7	2.5	4.4
45–49	95.2	51.4	2.5	3.6
50–54	93.3	50.5	2.6	2.8
55–59	89.6	45.9	3.2	2.9
60–64	77.4	32.7	3.4	2.7
65–69	41.7	17.2	4.2	3.1
70 and over	18.7	5.8	2.7	2.4

The second factor which had to be considered was mortality from causes other than the one under study. Even if a 16-year old motorcyclist is saved from fatal injury, he may succumb to some other cause before reaching normal retirement. To handle this factor, standard actuarial techniques were used; that is, mortality records were used to determine the proportion of males (females) of age a surviving to age n, and this proportion was then applied to the earnings in year n (adjusted as previously discussed) of any such male whose accidental death was prevented at age a.

The Discount Rate

Program Analysis 1966-1 stated that:

> Although there is agreement among economists that comparison of streams of earnings over varying time spans should employ the process of discounting, there is no agreement on the discount rate to be used. For purposes of this cost-benefit analysis, a basic discount rate of 6 percent is used.

The basic discount rate was then adjusted to reflect anticipated differential changes in prices. Over the ten-year period 1955–65, for example, medical care prices increased at a rate of approximately 2% per year faster than consumer prices. It was assumed that this differential rate of increase would continue and that it would apply to program costs as well. To convert the program costs given in Exhibit 1 into terms comparable to consumer prices, therefore, the costs given should be increased by a factor of 2% per year before discounting. Essentially the same result would be obtained by subtracting the 2% from the basic discount rate of 6%, given an adjusted rate of 4% for discounting program costs.

In the case of lifetime earnings, it was assumed that worker productivity would continue to increase at a rate of about 3% per year as it had on the average from 1947 to 1965 and that wages would grow with productivity. The effect of increasing wages was taken into account by subtracting this 3% from the basic discount rate, giving an adjusted rate of 3% for discounting lifetime earnings.