Time Loss and Indirect Economic Costs Caused by Disease Among Indians and Alaska Natives

a comparison with the general U.S. population

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IN RECENT YEARS, the programmatic approach to the development of health services increasingly has included estimation of the indirect cost engendered by reduced life expectancy and disability arising from disease or other conditions which prevent the attainment of a state of optimal health. The basic cost of depressed health status is time lost from the full desirable capacity or quality of life. From calculations of time lost from work force participation, estimates of the dollar value of lost economic productivity can be developed. Economic terms are marketplace terms; therefore, they are inadequate to describe the true worth of human life or the social value of the individual person. They may be used to quantitate, in part, the socioeconomic impact of ill health.

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In planning health activities, economic evaluations may assist in defining the magnitude of problems, in describing tangible benefits of problem solution, in determining program priorities, and in selecting program alternatives. They also may be used to quantify the character of the impact of a particular health problem; that is, whether the greater impact is the loss caused by acute disease, by residual or long-term disability, or by mortality. Such determinations may be of distinct value in planning the distribution of effort among the curative, preventive, or rehabilitative facets of health and medical services. Health agencies, such as the Indian Health Service of the Public Health Service, may be able to use economic cost projections to assist in determining the distribution of limited service resources among the array of evident health problems. Explorations of this potential provided the primary motivation for the study reported here.

General Study Rationale

In the development of the study we borrowed liberally from the concepts and approaches embodied in a publication of the Health Economics Branch of the Public Health Service (*1*). Be-

cause of the program interests of our agency and the characteristics of the population it serves, we have deviated to some extent from the approaches and methods described in the publication cited. The Indian Health Service deals with a minority group, the Indians and Alaska Natives. The total cost of disease among such a group is small in relation to the overall cost on the national scale. Therefore, to develop meaningful comparative data, the time and dollar costs are calculated in rates per 100,000 persons. The population of concern to the Indian Health Service is currently also an economically disadvantaged group, suffering a health status which is generally and substantially lower than the bulk of the U.S. population. The stated mission of the Indian Health Service is to raise the health status of the Indians and Alaska Natives to the highest possible level. Standards or criteria to define "highest possible level" cannot be set realistically except at the status of the general population or of the least disadvantaged population segment. The standards of life expectancy used in this study were those of "all races," that is, the general population. Consequently, the evaluations of death loss are, to a large extent, mission-oriented and comparative rather than absolute.

Rice and Cooper (*2*) have described an excellent method for computing economic loss caused by mortality on the basis of expected lifetime earnings. We were reluctant to use this approach, not because of lack of confidence in the method, but because the social ferment of the times portends considerable change in potential lifetime earnings of the persons currently under working age in disadvantaged minority groups. This would include all of the IHS service population under 15 years of age, which comprises a large proportion of the whole. We have, in one phase of the study, incorporated estimates of potential lifetime earnings obviated by death, but only in relation to the current work force. We feel justified in doing so for it is likely that the potential lifetime earnings of the Indians and Alaska Natives now in the work force may not change nearly so much as the potential lifetime earnings of their children, due to the implication of education and other acculturation factors.

For the reasons cited, whenever comparisons include all groups, the estimates of this study deal with economy of time. Dollar evaluations of mortality loss among children and youth of the Indians and Alaska Natives might more reasonably be left to the future when sophisticated economic appraisal of the effects of social change allow better projections of the earning potentials of the youth of currently disadvantaged groups.

The specific kinds of health statistics required for the type of study reported here are not all routinely collected at the present time. For optimal study of health economics, statistics are required on distribution of mortality, hospital days, outpatient (physician) visits, and restricted activity (other than outpatient or inpatient). All of these statistics should be available by sex and, preferably, by 5-year age groups and by major categories of the International Classification of Diseases, Adapted (ICDA) (*3*). The lack of sufficient detail in the available statistics forced us, at times, to calculate age-sex-cause distributions in manners which were more expeditious than desirable. A detailed description of methodology and formulation is given in the description of each facet of the study.

To illustrate conveniently the disparity between the health economics state of Indians and Alaska Natives in reference to all races, we calculated and tabulated "comparison ratios," which in general show how much worse the situation is among the Indians and Alaska Natives. In instances in which the comparison ratio drops lower than 1, the Indians possess a better status than all races with regard to a particular health problem.

Mortality Losses

Mortality rates provide a useful starting point in most approaches to the estimation of the indirect cost of disease. A comparison of the mortality rates in 1965, both crude and age-adjusted, is presented in table 1. The rates for Indians and Alaska Natives were derived from special tabulations provided to the Indian Health Service annually by the National Center for Health Statistics, Public Health Service (*4*). The statistics for all races were derived from the annual report of vital statistics of the United States (*5*). The rates shown in table 1 provide

Table 1. Comparison of death rates per 100,000 population, Indians and Alaska Natives versus all races, 1965

Selected ICDA categories	Crude cause-specific rates			Adjusted cause-specific rates		
	Indians and Alaska Natives	All races	Comparison ratio	Indians and Alaska Natives	All races	Comparison ratio
All causes	973. 5	943. 2	1. 03	1, 208. 3	779. 7	1. 54
Infective and parasitic diseases	51. 2	9. 2	5. 56	59. 8	8. 1	7. 38
Neoplasms	79. 5	156. 1	. 50	120. 4	132. 4	. 90
Allergic, endocrine, and metabolic diseases	30. 6	22. 8	1. 34	45. 1	18. 9	2. 38
Diseases of blood and blood-forming organs	3. 6	2. 9	1. 24	3. 6	2. 4	1. 50
Mental and psychoneurotic disorders	11. 2	2. 6	4. 30	17. 4	2. 6	6. 69
Diseases of the nervous system	63. 1	111. 4	. 56	86. 3	87. 4	. 98
Diseases of the circulatory system	160. 3	407. 2	. 39	245. 9	325. 1	. 75
Diseases of the respiratory system	93. 2	51. 5	1. 80	86. 9	41. 3	2. 10
Diseases of the digestive system	78. 2	37. 1	2. 10	91. 1	32. 2	2. 82
Diseases of the genitourinary system	20. 8	15. 7	1. 32	31. 7	13. 2	2. 40
Pregnancy and complications	2. 9	. 6	4. 83	4. 1	. 8	5. 10
Diseases of skin and cellular tissue	2. 1	1. 1	1. 90	3. 3	1. 0	3. 30
Diseases of bone and organs of movement	1. 6	2. 0	. 80	2. 0	1. 7	1. 17
Congenital malformations	19. 0	10. 1	1. 88	8. 7	8. 2	1. 06
Certain diseases of early infancy	59. 0	28. 6	2. 06	23. 2	22. 0	1. 05
Symptoms, senility, and ill-defined conditions	68. 3	12. 1	5. 64	83. 5	10. 2	8. 19
Accidents, poisons, and violence	229. 1	72. 4	3. 16	295. 5	72. 1	4. 09

strong indications of the great disparity of the health status of Indians and Alaska Natives in comparison with the general population.

The comparison of crude rates shows that, in 13 of the 17 ICDA categories of disease, the Indian death rate is significantly or greatly increased over that of all races. While the crude death rates indicate that the Indians and Alaska Natives have less death loss than all races in four disease categories, adjusted death rates indicate a significantly more favorable health status for Indians in only one category (diseases of the circulatory system).

Mortality rates, in themselves, do not provide clear indices of the comparative indirect costs. They assume meaningful dimensions only when converted to show the cost in life-years lost, short of expectancy. These calculations are presented in table 2. As mentioned previously, for the comparative purposes of this study it was desirable to employ only one set of criteria of expectancy. Currently, at any age, the Indian enjoys less life expectancy than is calculated for all races.

To provide uniform comparison and to show the deficiency in relation to the goal of the Indian Health Service, the all races life-expectancy tables were used to calculate years lost at average age of death, for both groups in each disease category. The formula then becomes $Y=R(E-D)$, where Y is the number of man-years lost per 100,000, R is the unadjusted cause-specific death rate, E is the all races life expectancy at the age at which death occurred, and D is the average age at death of the group and cause under consideration. The quantity $(E-D)$ represents average number of years of loss of life expectancy per person. Table 2 presents component data and the calculated years of life lost by Indians and Alaska Natives and by the general population (all races) in each major ICDA category of disease.

The development of analyses of the economic impact of death are based on the assumption that each person who dies before fulfilling the life expectancy of his age-sex cohort generates an economic loss because of the obviation of potential productivity. Some arguments may be raised against this assumption. First, although the years lost by persons dying short of their normal life expectancy may represent a loss of productivity, some economists argue that this also represents a loss to consumption and that, consequently, the loss caused by early death

should be represented only by the value of potential production in excess of the value of potential consumption (*6*).

Furthermore, economic projections do not usually take into consideration the bionomic implications of the alternative, hypothetical situation in which all persons would successfully survive the biological and physical hazards to health and live to old age, when natural senescence would inevitably bring about cessation of life. Surely, such a state would bring about profound economic changes, both positive and negative, such as greatly increased consumption, an intense competition for employment, and a much larger nonproductive segment of society.

The data in table 2 show the additional dimension of description of the impact of disease provided by the calculation of years lost due to mortality. This is particularly significant in comparison of loss due to disease among Indians and Alaska Natives with that of all races, for the former group had a lower average age of death in all categories of disease, even the diseases commonly associated with aging, such as heart disease, cancer, and stroke. Overall, the average age at death of Indians and Alaska Natives was 21.4 years less than that of all races (43.5 in contrast to 64.9).

A calculation of the dollar value of the man-years of obviated life might have been made, employing the method described by Rice (*2*). We did not calculate comparative losses on this basis for the reasons cited before (see General Study Rationale). We were unwilling to calculate the future economic potential of a socially and economically disadvantaged people at a time when legislative, social, and economic signs portend a considerable reduction of the disadvantagement within a generation.

In earlier stages of the study, we strove to derive a dollar value for the net individual worth, regardless of age, sex, condition, or socioeconomic grouping. We tried using a theoretical per capita "share" in the gross national product as an expression of common individual worth; this was $3,815 for 1965—surprisingly close to the median per capita value of income for all races for the same year. The use of this per capita "share" in the GNP was adversely criticized, for valid reasons, by eminent economists who reviewed the study; therefore, evaluations on this basis were eliminated from this report.

Indirect Cost Implications

Three sets of statistics can be employed to derive estimates of the time and indirect economic impact of morbidity. These are the statistics on (*a*) patient days of hospitalization, (*b*) number of outpatient and physician visits, and (*c*) disability days outside of direct institutional care. All of these types of data are currently obtained by special survey rather than routine, blanket reporting through health administration channels. They are not reported in uniform detail by sex, age, and race in addition to totals by ICDA category. The disparity of detail in reporting such statistics caused considerable difficulty in the development of this study. In most cases, age-sex-cause distributions of hospitalization, physician visits, and restricted activity (noninstitutional) had to be constructed by integrating health statistics from various sources.

Two sources of information on hospitalization of all races were consulted. One was the 1966 publication by the Commission on Professional and Hospital Activities (CPHA) (*7*). The other was, compositely, three publications of the National Center for Health Statistics (NCHS) (*8–10*). The total number of hospital days for the year reported here was obtained from the NCHS publication Series 10, No. 50, while age-sex-cause distributions were constructed from tabular information in Series 10, No. 30, and Series 13, No. 1. The age-cause distribution totals which were obtained from the CPHA publication varied considerably from those obtained from the NCHS studies; therefore, we chose to use the NCHS data, primarily because they offered the opportunity for construction of age-sex-cause distributions. Hospitalization information about Indians and Alaska Natives was obtained from Indian Health Service administrative data (*11*). This information did not provide age-sex distribution. The age-sex distribution of Indian outpatient visits was applied to derive age-sex distribution of hospital days.

The numbers of physician (outpatient) visits by the general population (all races) by ICDA

classification of cause were obtained from quarterly reports of the National Disease and Therapeutic Index (*12*), while sex-age distributions of persons making physician visits were obtained from a NCHS publication (*13*). The data on Indian outpatient visits, obtained from a special outpatient service survey conducted by the Indian Health Service (*14*), included cause, age, and sex distribution of physician visits. For both all races and Indians, one physician visit was counted as one-third of a day lost.

The data on the cause-age-sex distribution of restricted activity (disability) among all races occurring outside medical institutions were derived by the integration of information selected from three NCHS publications (*15–17*). This was corroborated by comparison with NCHS unpublished data on restricted activity for all races, July 1964 to July 1965. Numerical data were obtained from 1965–66 publications, while cause-age-sex distribution data from earlier years were used when similar 1965–66 information was not available.

No information was available on the amount of restricted activity (disability) among Indians and Alaska Natives occurring outside medical institutions. This was constructed by first deriving the ratio between hospital days and disability days by cause among all races. This ratio was then used to calculate restricted activity days for Indians and Alaska Natives. This approach is expressed in the following formula:

$$\text{Restricted activity days (Indians)} = \text{hospital days (Indians)} \times \frac{\text{restricted activity days (all races)}}{\text{hospitalization days (all races)}}.$$

Hospitalization time was selected as the basis for deriving the ratio because this phase of health services to Indians and Alaska Natives more nearly approaches the level of service available to all races. We assumed that Indians and Alaska Natives experienced at least as much restricted activity in relation to hospitalization as did all races.

Outpatient visits were not used as a basis for the calculation because, despite the large increases in outpatient services to Indians and Alaska Natives in recent years, geographic factors alone prevent the provision of opportunity for physician visits to the level available to the general population. Mortality rate was not taken as a basis for derivation of restricted activity ratio because, to a far greater extent than among all races, mortality among Indians and Alaska Natives appears to be governed by ecological and socioeconomic factors.

Table 3 presents the calculated time losses per 100,000 population caused by morbidity as expressed in hospitalization, in physician visits, and in restricted activity resulting from acute and chronic disease (including injury). It is quite evident that, by far, the major amount of time loss due to morbidity is caused by restricted activity or disability occurring outside of medical institutional care.

To obtain the total within-year time loss due to mortality we assumed that deaths were distributed randomly; therefore, the average time loss per death was ½ year. Accordingly, the cause-specific loss in man-years per 100,000 population became one-half the unadjusted death rate. It is apparent from the data in table 3 that within-year time loss caused by mortality is not a major component of the total. Further, in only four of the 17 disease categories did within-year mortality loss comprise a major proportion of the total morbidity and mortality time loss for the category, and the summation of the losses in these four categories did not comprise a major proportion of the overall total. Comparison of total within-year time loss between Indians and Alaska Natives and all races showed a significantly greater loss for the former in 10 of 17 categories. The loss in the infective disease category was strikingly greater for Indians and Alaska Natives.

To complete the comparison of time loss of all ages and sexes, the total morbidity loss (extracted from table 3) and total life expectancy loss (extracted from table 2) were summarized by ICDA classes. The data are presented in table 4. Adding all the years of obviated life changed the comparison ratios considerably, primarily because of the earlier average age at death of Indians and Alaska Natives. In 15 of the 17 ICDA categories the data showed a greater time loss for Indians and Alaska Natives, while the interplay of relative weights of

within-year morbidity loss and full-life expectancy mortality loss caused considerable change in the comparison ratios.

A number of intriguing epidemiologic characterizations of disease categories might be drawn from a comparative study of the time loss effects of within-year morbidity, of within-year mortality, and of obviated life expectancy. Time and space do not allow extensive discussion. Furthermore, one large morbidity category, restricted activity, had to be constructed inferentially for Indians and Alaska Natives by application of a ratio derived from all races experience; therefore, hard epidemiologic comparisons cannot be made until reliable survey data on restricted activity are available for Indians and Alaska Natives.

Economic Loss, Work Force

One more commonly used measure of the indirect economic cost of disease is the loss in potential wages caused by death and disability among the segments of the population comprising the work force of the nation. This type of analysis has limited relevance to the health status of the general population, for only that portion of the population 15 years of age and older is considered part of the work force. In some work force analyses, the groups 65 years of age and older are also excluded. Undoubtedly the epidemiologic character of morbidity and mortality occurring in the age groups 15 to 64 years is considerably different from that which occurs in the younger and older groups. Nevertheless, work force economic loss estimations have the advantage of providing relatively reliable measurement of disease impact in terms of dollars, since human effort in the form of services or products enters the marketplace and obtains an economic value. An additional advantage is the fact that the comparative impact of morbidity and mortality can be measured in dollar values.

The basic statistics entering the calculation of work force were the distributions of time loss caused by hospitalization, physician visits, restricted activity other than institutional, and mortality—all by 5-year age groups, sex, and ICDA major disease category. These age-sex-cause time loss figures were modified by the factor of work force participation of each age-sex group to yield time loss within each work force age and sex group, by each major ICDA cate-

Table 2. Man-years lost due to mortality per 100,000 population, Indians and Alaska Natives and all races, by selected ICDA categories, 1965–66

Selected ICDA categories	Unadjusted cause-specific death rates		Average age at death		Years lost due to mortality		Comparison ratio
	Indians and Alaska Natives	All races	Indians and Alaska Natives	All races	Indians and Alaska Natives	All races	
All causes	973. 5	943. 2	43. 5	64. 9	31, 470	14, 770	2. 1
Infective and parasitic diseases	51. 2	9. 2	40. 8	54. 3	1, 700	205	8. 3
Neoplasms	79. 5	156. 1	62. 7	66. 8	1, 264	2, 091	. 6
Allergic, endocrine, and metabolic diseases	30. 6	22. 8	59. 1	67. 3	569	306	1. 9
Diseases of blood and blood-forming organs	3. 6	2. 9	34. 5	59. 3	139	54	2. 6
Mental and psychoneurotic disorders	11. 2	2. 6	47. 4	51. 7	314	62	5. 1
Diseases of nervous system	63. 1	111. 4	57. 4	72. 9	1, 268	1, 114	1. 1
Diseases of circulatory system	160. 3	407. 2	67. 6	72. 7	2, 052	4, 072	. 5
Diseases of respiratory system	93. 2	51. 5	32. 5	62. 1	3, 775	850	4. 4
Diseases of digestive system	78. 2	37. 1	35. 2	62. 0	3, 026	612	4. 9
Diseases of genitourinary system	20. 8	15. 7	63. 7	67. 4	316	210	1. 5
Pregnancy and complications	2. 9	. 6	30. 0	29. 9	126	26	4. 8
Diseases of skin and cellular tissue	2. 1	1. 1	59. 9	61. 8	38	18	2. 1
Diseases of bone and organs of movement	1. 6	2. 0	31. 8	60. 7	66	34	1. 9
Congenital malformations	19. 0	10. 1	3. 7	8. 7	1, 294	639	2. 0
Certain diseases of early infancy	59. 0	28. 6	. 5	. 5	4, 183	2, 028	2. 1
Symptoms, senility, and ill-defined conditions	68. 3	12. 1	40. 5	58. 2	2, 268	234	9. 7
Accidents, poisons, and violence	229. 1	72. 4	33. 6	44. 3	9, 072	2, 215	4. 1

Table 3. Estimates of man-years lost per 100,000 population due to morbidity and within-year mortality loss, by ICDA categories, 1965–66

Selected ICDA categories	Hospitalization		Physician visits		Restricted activity		Mortality		Total		Comparison ratio
	Indians and Alaska Natives	All races	Indians and Alaska Natives	All races	Indians and Alaska Natives	All races	Indians and Alaska Natives	All races	Indians and Alaska Natives	All races	
All causes	816	466	252	662	13, 765	4, 222	523	473	15, 356	5, 823	2. 6
Infective and parasitic diseases	138	6	26	13	6, 721	292	26	5	6, 911	316	21. 9
Neoplasms	25	30	1	16	22	26	40	78	88	150	. 6
Allergic, endocrine, and metabolic diseases	28	12	11	50	229	98	15	11	283	171	1. 7
Diseases of blood and blood-forming organs	5	3	1	9			2	2	8	14	. 6
Mental and psychoneurotic disorders	21	10	5	27	189	90	6	1	221	128	1. 7
Diseases of the nervous system	61	19	22	50	604	189	32	56	719	314	2. 3
Diseases of the circulatory system	35	39	7	64	301	336	80	204	423	643	. 7
Diseases of the respiratory system	105	56	56	77	2, 121	1, 135	47	26	2, 329	1, 294	1. 8
Diseases of the digestive system	85	68	18	35	255	204	39	19	397	326	1. 2
Diseases of the genito-urinary system	37	38	7	40	104	105	10	8	158	191	. 8
Pregnancy and complications	63	80	9	9	48	61	2		122	150	. 8
Diseases of skin and cellular tissue	25	7	13	16	86	24	1	1	125	48	2. 6
Diseases of bone and organs of movement	27	16	7	37	764	437	1	1	799	491	1. 6
Congenital malformations	13	3	1	2			10	5	24	10	2. 4
Certain diseases of early infancy	10	5		1			30	14	40	20	2. 0
Symptoms, senility, and ill-defined conditions	12	26	6	27			34	6	52	59	. 9
Accidents, poisons, and violence	91	48	20	52	2, 321	1, 225	148	36	2, 580	1, 361	1. 9
All other conditions	35		42	137					77	137	. 6

gory of disease. The sum of the time losses of all of the age-sex groups within each ICDA category yielded the total time loss for that category. In one analysis, time loss by all disease categories was summarized to yield the time loss by each age-sex group for all causes.

Income levels were also derived for each sex group, using labor statistics available on Indians and Alaska Natives and all races (*18*, *19*). In our analysis we used the median income as the dollar basis. Other medical economics studies use the average income. We decided against the average income, because it is heavily influenced by the fact that the major proportion of earnings in the nation is paid to a minority of the population. We felt that the median income would yield a far more equitable comparison of the health economic status of the work force of Indians and Alaska Natives with that of all races, particularly since a much smaller proportion of the Indian and Alaska Native population could be considered part of the high-income groups than of all races. From available labor statistics, the median income by 5-year age groups over age 14 was calculated separately for Indians and Alaska Natives and for all races. Since the latest information on Indian and Alaska Native income was obtained in 1959, the levels were increased by the same proportion as the increase for all races income between 1959 and 1965.

Indirect economic losses were calculated by age-sex group. The totals by cause or by age-sex group in tables 4, 5, and 6 were obtained by summation. The overall median yearly income level for the all races work force was calculated

as $3,694 and for Indians and Alaska Natives it was $1,962. The replacement value of housewifery was taken as $2,767 (*2*).

In the portions of the study which deal with dollar value of loss of life expectancy among the work force, we did not discount estimates of future earnings in order to present their current value. Again, this was a deviation from standard economic practice and its rationale was based on socioeconomic and health status disparities between the Indians and Alaska Natives and all races. As shown before, the average age at death from all causes of Indians and Alaska Natives was more than 20 years lower than that of all races. Therefore, had we discounted potential earnings to estimate current value, the Indian and Alaska Native potential earnings overall would have been depreciated over a period 20 years greater than the depreciation period of all races. Accordingly, since our objective was to compare health status rather than to calculate current economic value, our death loss comparisons were stated purely in terms of the gross value of potential future compensation. It appeared to us that to impose an excess discount on the already disadvantaged economic status of the Indians and Alaska Natives would make our evaluations inequitable and would greatly reduce the clarity of comparisons of health status of the two groups.

Table 5 presents comparisons, by cause and sex, of time loss and economic loss resulting from morbidity and within-year mortality loss within the work force. The comparison ratios reveal significantly greater time loss among Indians and Alaska Natives versus all races in 13 of the 17 ICDA categories. However, with regard to calculated potential earnings, the estimated loss among Indians was greater in only eight of the 17 categories and the comparison ratios were greatly reduced except for the category "diseases of skin and cellular tissue." The

Table 4. Estimates of man-years lost per 100,000 population due to morbidity and loss in life expectancy, by ICDA categories, 1965–66

Selected ICDA categories	Morbidity			Mortality			Total		
	Indians and Alaska Natives	All races	Comparison ratio	Indians and Alaska Natives	All races	Comparison ratio	Indians and Alaska Natives	All races	Comparison ratio
All causes	14, 833	5, 347	2. 8	31, 470	14, 770	2. 1	46, 303	20, 117	2. 3
Infective and parasitic diseases	6, 885	311	22. 1	1, 700	205	8. 3	8, 585	516	16. 6
Neoplasms	48	72	. 7	1, 264	2, 091	. 6	1, 312	2, 163	. 6
Allergic, endocrine, and metabolic diseases	268	160	1. 7	569	306	1. 9	837	466	1. 8
Diseases of blood and blood-forming organs	6	12	. 5	139	54	2. 6	145	66	2. 2
Mental and psychoneurotic disorders	215	127	1. 7	314	62	5. 1	529	189	2. 8
Diseases of the nervous system	687	258	2. 6	1, 268	1, 114	1. 1	1, 955	1, 372	1. 4
Diseases of the circulatory system	343	439	. 8	2, 052	4, 072	. 5	2, 395	4, 511	. 5
Diseases of the respiratory system	2, 282	1, 265	1. 8	3, 775	850	4. 4	6, 057	2, 115	2. 9
Diseases of the digestive system	358	307	1. 2	3, 026	612	4. 9	3, 384	919	3. 7
Diseases of the genitourinary system	148	183	. 8	316	210	1. 5	464	393	1. 2
Pregnancy and complications	120	150	. 8	126	26	4. 8	246	176	1. 4
Diseases of skin and cellular tissue	124	47	2. 6	38	18	2. 1	162	65	2. 5
Diseases of bone and organs of movement	798	490	1. 6	66	34	1. 9	864	524	1. 6
Congenital malformations	14	5	2. 8	1, 294	639	2. 0	1, 308	644	2. 0
Certain diseases of early infancy	10	6	1. 7	4, 183	2, 028	2. 1	4, 193	2, 034	2. 1
Symptoms, senility, and ill-defined conditions	18	53	. 3	2, 268	234	9. 7	2, 286	287	8. 0
Accidents, poisons, and violence	2, 432	1, 325	1. 8	9, 072	2, 215	4. 1	11, 504	3, 540	3. 3
All other conditions	77	137	. 6				77	137	. 6

change in comparison ratios is due to the considerably larger median income of all races. Nevertheless despite the overall economic disadvantagement, the calculated loss in gross potential earnings of Indians and Alaska Natives was greater than that of all races.

Table 6 presents the comparative calculations of work force time loss, including morbidity

Table 5. Estimated within-year indirect cost of mortality [1] and morbidity among work force, Indians and Alaska Natives and all races, by sex and ICDA disease categories, 1965–66

Selected ICDA categories	Time loss [1]			Potential earnings loss [2]		
	Indians and Alaska Natives	All races	Comparison ratio	Indians and Alaska Natives	All races	Comparison ratio
All causes	6,013	3,337	1.8	$12,736	$11,728	1.1
Male	3,350	1,716	2.0	9,395	8,791	1.1
Female	2,663	1,621	1.7	3,341	2,937	1.1
Infective and parasitic diseases	1,063	82	13.0	2,284	327	7.0
Male	653	52	12.6	1,802	269	6.7
Female	410	30	13.7	482	58	8.3
Neoplasms	334	564	.6	660	1,909	.3
Male	121	227	.5	381	1,230	.3
Female	213	337	.6	279	679	.4
Allergic, endocrine, and metabolic diseases	304	111	2.7	634	340	1.9
Male	120	47	2.6	381	228	1.7
Female	184	64	2.9	253	112	2.2
Diseases of blood and blood-forming organs	8	12	.7	13	35	.4
Male	2	4	.5	6	23	.3
Female	6	8	.8	7	12	.6
Mental and psychoneurotic disorders	106	23	4.6	241	117	2.1
Male	61	16	3.8	178	94	1.9
Female	45	7	6.4	63	23	2.7
Diseases of the nervous system	289	291	1.0	533	796	.7
Male	121	105	1.2	317	504	.6
Female	168	186	.9	216	292	.7
Diseases of the circulatory system	607	1,100	.6	1,320	3,782	.3
Male	334	571	.6	919	2,951	.3
Female	273	529	.5	401	831	.5
Diseases of the respiratory system	213	134	1.6	406	468	.9
Male	99	76	1.3	266	363	.7
Female	114	58	2.0	140	105	1.3
Diseases of the digestive system	471	204	2.3	977	808	1.2
Male	197	110	1.8	634	621	1.0
Female	274	94	2.9	343	187	1.8
Diseases of the genitourinary system	137	87	1.6	266	293	.9
Male	61	43	1.4	178	199	.9
Female	76	44	1.7	88	94	.9
Pregnancy and complications of pregnancy	91	32	2.8	114	70	1.6
Diseases of skin and cellular tissue	45	12	3.8	185	35	5.3
Male	15	4	3.8	146	19	7.7
Female	30	8	3.8	39	16	2.4
Diseases of bone and organs of movement	152	96	1.6	267	304	.9
Male	77	48	1.6	216	211	1.0
Female	75	48	1.6	51	93	.5
Congenital malformations	6	13	.5	14	43	.3
Male	5	6	.8	13	30	.4
Female	1	7	.1	1	13	.1
Symptoms, senility, and ill-defined conditions	213	41	5.2	457	164	2.8
Male	102	23	4.4	316	129	2.4
Female	111	18	6.2	141	35	4.0
Accidents, poisons, and violence	1,974	535	3.7	4,365	2,237	2.0
Male	1,382	384	3.6	3,642	1,920	1.9
Female	592	151	3.9	723	317	2.3

[1] In man-years per 100,000 population per year.
[2] In thousands of dollars per 100,000 population per year.

and obviated life expectancy due to mortality, and consequent loss in potential earnings. Because of the addition of all years of obviated life expectancy, both the time loss and economic loss estimates are much greater than with the within-year estimates of table 5. All the comparison ratios decrease in relation to those of table 5. The probable cause of this decrease is

Table 6. Estimated time and potential earnings loss due to mortality among Indians and Alaska Natives and all races, by sex and ICDA disease categories, 1965–66

Selected ICDA categories	Time loss [1]			Potential earnings loss [2]		
	Indians and Alaska Natives	All races	Comparison ratio	Indians and Alaska Natives	All races	Comparison ratio
All causes	18, 315	11, 533	1. 6	$38, 455	$40, 586	0. 9
Male	10, 051	5, 925	1. 7	28, 376	30, 440	. 9
Female	8, 264	5, 608	1. 5	10, 079	10, 146	1. 0
Infective and parasitic diseases	3, 206	282	11. 4	6, 897	1, 135	6. 1
Male	1, 982	181	11. 0	5, 441	932	5. 8
Female	1, 224	101	12. 1	1, 456	203	7. 2
Neoplasms	1, 014	1, 951	. 5	1, 992	6, 604	. 3
Male	369	784	. 5	1, 149	4, 254	. 3
Female	645	1, 167	. 6	843	2, 350	. 4
Allergic, endocrine, metabolic diseases	922	382	2. 4	1, 916	1, 175	1. 6
Male	375	161	2. 3	1, 125	729	1. 5
Female	547	221	2. 5	791	446	1. 8
Diseases of blood and blood-forming organs	23	40	. 6	48	122	. 4
Male	5	14	. 4	24	80	. 3
Female	18	26	. 7	24	42	. 6
Mental and psychoneurotic disorders	322	80	4. 0	727	405	1. 8
Male	138	56	2. 5	556	324	1. 7
Female	184	24	7. 7	171	81	2. 1
Diseases of the nervous system	875	1, 006	. 9	1, 609	2, 755	. 6
Male	369	362	1. 0	968	1, 742	. 6
Female	506	644	. 8	641	1, 013	. 6
Diseases of the circulatory system	1, 935	3, 803	. 5	3, 985	13, 087	. 3
Male	922	1, 971	. 5	2, 774	10, 211	. 3
Female	1, 013	1, 832	. 6	1, 211	2, 876	. 4
Diseases of the respiratory system	645	463	1. 4	1, 226	1, 620	. 8
Male	310	262	1. 2	805	1, 256	. 6
Female	335	201	1. 7	421	364	1. 2
Diseases of the digestive system	1, 428	704	2. 0	2, 950	2, 796	1. 1
Male	599	382	1. 6	1, 906	2, 147	. 9
Female	829	322	2. 6	1, 044	649	. 6
Diseases of the genitourinary system	415	302	1. 4	805	1, 013	. 8
Male	186	148	1. 3	516	703	. 7
Female	229	154	1. 5	289	310	. 9
Pregnancy and complications	277	121	2. 3	345	243	1. 4
Diseases of skin and cellular tissue	138	32	4. 3	559	122	4. 6
Male	42	14	3. 0	440	65	6. 8
Female	96	18	5. 3	119	57	2. 1
Diseases of bone and organs of movement	461	331	1. 4	795	1, 053	. 8
Male	235	167	1. 4	641	739	. 9
Female	226	164	1. 4	154	314	. 5
Congenital malformations	18	44	. 4	42	150	. 3
Male	16	20	. 6	40	103	. 4
Female	2	24	. 1	2	47	. 04
Symptoms, senility, and ill-defined conditions	645	141	4. 6	1, 379	567	2. 4
Male	309	76	4. 1	958	432	2. 2
Female	336	65	5. 2	421	135	3. 1
Accidents, poisons, and violence	5, 991	1, 851	3. 2	13, 180	7, 739	1. 7
Male	4, 194	1, 327	3. 2	10, 996	6, 645	1. 7
Female	1, 797	524	3. 4	2, 184	1, 094	2. 0

[1] In man-years per 100,000 population per year.
[2] In thousands of dollars per 100,000 population per year.

the porportionately greater number of persons in the advanced age groups of the all races work force, because for Indians and Alaska Natives natural attrition has greatly reduced the proportions of persons in advanced age groups. With regard to economic loss, the decrease in comparison ratios is, again, due to the proportionately larger median income of all races augmented by the factor of a greater life expectancy.

To complete the comparisons, time loss and economic loss were compiled for all causes by age-sex groups (table 7). These comparisons indicate an interplay between work force participation and morbidity and mortality loss to a greater extent than apparent in the previous comparison by disease categories. Note the shift in time loss comparison ratio values in the age groups 15–19, 20–24, and 25–34. The high comparison ratio of the 15–19 age group probably indicates a larger work force participation of Indians and Alaska Natives at a period of life when most persons of all races are continuing their education. The comparative participation and time loss tend to even out in the 20–24 age group. We interpret the surge in time loss in the 25–34 age group as an indication of a surge in mortality. Thereafter, the comparison ratios decline as both the attrition in size of Indian and Alaska Native age groups takes effect coupled with the gradual increase in mortality in all races. The gradual decline in comparison ratios of loss in potential earnings is probably derived not only from changes in comparative numbers of work force participants, but also the great disparity in median income.

Discussion

This study was started as an effort to derive epidemiologically based statistics which might help to establish objectives and priorities in a comprehensive health service program with the mission to raise the health status of a socially

Table 7. Estimated indirect costs of premature death and morbidity among work force, total man-years lost and potential earnings lost, by age and sex, Indians and Alaska Natives and all races, 1965

Age groups (years) and sex	Time loss [1]			Potential earnings loss [2]		
	Indians and Alaska Natives	All races	Comparison ratio	Indians and Alaska Natives	All races	Comparison ratio
Total	18,938	11,626	1.6	$41,020	$38,124	1.1
Male	10,534	5,573	1.9	29,100	28,597	1.0
Female	8,404	6,053	1.4	11,920	9,527	1.3
15–19	844	235	3.6	515	103	5.0
Male	550	165	3.3	348	75	4.6
Female	294	70	4.2	167	28	6.0
20–24	1,621	1,228	1.3	2,643	1,327	2.0
Male	981	305	3.2	1,806	974	1.9
Female	640	923	.7	837	353	2.4
25–34	3,704	846	4.4	8,321	3,825	2.2
Male	2,172	511	4.2	6,450	3,070	2.1
Female	1,532	335	4.6	1,871	755	2.5
35–44	3,481	1,481	2.4	9,848	7,240	1.4
Male	1,893	842	2.2	6,177	5,653	1.1
Female	1,588	639	2.5	3,671	1,587	2.3
45–54	3,536	2,373	1.5	9,255	11,347	.8
Male	1,954	1,387	1.4	7,066	8,824	.8
Female	1,582	986	1.6	2,189	2,523	.9
55–64	3,330	2,785	1.2	7,546	10,778	.7
Male	1,878	1,595	1.2	5,927	8,376	.7
Female	1,452	1,190	1.2	1,619	2,402	.7
65 and over	2,422	2,678	.9	2,892	3,504	.8
Male	1,106	768	1.4	1,326	1,625	.8
Female	1,316	1,910	.7	1,566	1,879	.8

[1] In man-years per 100,000 population per year.
[2] In thousands of dollars per 100,000 population per year.

deprived, economically disadvantaged, and medically indigent minority group. The aim was to develop relevant statistics on the amount of living time which is rendered ineffective by morbidity, or lost due to mortality, and to translate these into dollar expressions of indirect economic loss for program justification and development on a cost-benefit basis.

We found the development of statistics on time loss to be a potentially extremely valuable tool for demonstrating and quantitating needs for preventive, therapeutic, and rehabilitative health and medical services, as well as to set goals for accomplishment. However, more detailed, comprehensive, and precise health statistics are required than those currently provided, if time-loss estimates are to be developed and used with confidence. It is particularly desirable that the outpatient and restricted activity (disability) statistics of the future be gathered in reference to important, specific disease entities rather than only groups of diseases such as those encompassed in the ICDA major categories. The time-loss approach is adaptable to comparisons involving both morbidity and mortality and the full range of age and sex grouping of the population. It is extremely useful to create a "four dimensional" measurement of health status.

The efforts to obtain expressions of indirect economic loss which would be epidemiologically meaningful in planning a comprehensive health service program for a disadvantaged minority were not successful due to the established ground rules of the field of economics. In essence, epidemiologic philosophy and economic philosophy are not entirely compatible because they differ in valuation of segments of society and of the individual person. Epidemiology is concerned with the ecology of disease in all segments of a population, while economics is concerned primarily with those segments having marketplace significance. For instance, the indirect economic cost of disease among children can be measured only in regard to the reduction caused by mortality in the future labor force. Current illness or depressed health in a child has no indirect economic cost value unless it has a measurable effect upon future productivity. The same is true of groups or individuals who are not or will not be involved in the work force. The value of a housewife can be figured only at the cost of replacement with a domestic, despite the fact that the domestic rarely provides the full extent, either in quality or quantity, of services provided by a housewife and mother.

We do not feel qualified to take sides in the controversies which are part of the natural development of medical economics. For our purposes, it is sufficient to indicate where epidemiologic objectives are well served by the present state of medical economics and where the two fields are incongruous. The development of our study has shown how the application of generally accepted formulations for calculation of indirect economic costs of disease may lead to a large understatement of health status, as indicated by epidemiologic facts, in an economically disadvantaged minority when compared with the general population or a more advantaged segment of it. This is amply demonstrated in the data of table 5 which deal with time and potential earnings lost caussd by morbidity and within-year mortality loss among the work force.

The understatement is augmented by consideration of total life expectancy obviated by early death, as shown in table 6, because of the great disparity in median income between the disadvantaged minority and the general population or another advantaged group taken for comparison. When the minority group also has a much earlier age at death than the reference population, in relation to a single expectancy criterion, then the understatement is compounded greatly by discounting potential future earnings in order to state the loss in terms of current value.

It is not likely that parity of evaluations can be established by a restatement of formulation for estimation of indirect economic cost of disease. Nor is there a way to calculate the indirect cost of disease among a population not in the work force. If dollar values must be obtained for cost-benefit evaluations of comprehensive, cradle-to-grave health programs, they might be sought better in the estimation of reductions in direct cost of medical care or of welfare support that might be attained by aggressive prevention

programs or by improved systems for treatment or rehabilitation.

We believe estimates of time lost due to restricted activity at home and in obtaining medical services or treatment, as well as life obviated by early death, comprise the most relevant statistics for development and justification of a health care program. For a disadvantaged group, the program planner should consider both the quantitation of time loss as well as the comparison of losses between the disadvantaged group and the criterion group, such as the general population or a more advantaged segment thereof. From the socioeconomic viewpoint, it probably is a mistake to base health program planning primarily on mortality statistics or on statistics heavily weighted by mortality loss. Loss due to morbidity is a matter of prime concern in health planning. The disease categories that produce the greater amount of morbidity are not necessarily those which produce the greater amount of mortality, as illustrated by comparisons in table 8. The only ICDA category which appears consistently in the upper priority rankings, according to mortality rate or quantity of time loss caused by mortality and morbidity, for both the Indians and Alaska Natives and the general population, is "accidents, poisons, and violence." We must qualify this and the other data of our study in one regard: it excludes that part of both population categories which is committed to long-term institutional custody.

Table 8 also shows the shift in priorities caused by incorporation of indirect economic loss caused by both morbidity and mortality. Only the work force can be included in such calculations, and the epidemiologic experience

Table 8. Ranking order of quantitative importance of major disease categories, according to various methods of calculation of impact

Selected ICDA categories	Death rates				Time loss				Work force economic loss			
	Crude death rate [1]		Adjusted death rate [1]		Morbidity and within-year mortality [2]		Morbidity and life expectancy loss [3]		Morbidity and within-year mortality [4]		Morbidity and life expectancy loss [5]	
	I	AR	I	AR	I	AR	I	AR	I	AR	I	AR
Infective and parasitic diseases	9		8		1	6	1	10	2	8	2	8
Neoplasms	4	2	3	2		[6] 10	8	3	5	3	5	3
Allergic, endocrine, and metabolic disease	10	8	9	8	8	9			6	7	6	7
Diseases of blood and blood-forming organs												
Mental and psychoneurotic disorders												
Diseases of the nervous system	7	3	6	3	5	7	7	6	7	5	7	5
Diseases of the circulatory system	2	1	2	1	6	3	6	1	3	1	3	1
Diseases of the respiratory system	3	5	5	5	3	2	2	4	9	6	9	6
Diseases of the digestive system	5	6	4	6	7	5	5	7	4	4	4	4
Diseases of the genitourinary system		9	10	9	9	8		0	[6] 10	[6] 10	[6] 10	[6] 10
Complications of pregnancy					[6] 10	[6] 10						
Diseases of skin and cellular tissue					[6] 10							
Diseases of bone and organs of movement					4	4	10	9	[6] 10	9	[6] 10	9
Congenital malformations							9	8				
Certain diseases of early infancy	8	7		7			3	5				
Symptoms, senility, and ill-defined conditions	6	10	7	10					8		8	
Accidents, poisons, and violence	1	4	1	4	2	1	4	2	1	2	1	2

[1] Source of data, table 1.
[2] Source of data, table 3.
[3] Source of data, table 4.
[4] Source of data, table 5.
[5] Source of data, table 6.
[6] Causes were of almost equal importance.

NOTE: I—Indians and Alaska Natives; AR—all races.

of the work force is qualitatively and quantitatively different from that of a population with full age range. In addition, we believe that time loss calculations including morbidity and mortality are probably more representative of epidemiologic reality when they are restricted to within-year loss. While the incorporation of total loss in life expectancy produces more impressive quantitative totals, it also gives mortality a predominant role in epidemiologic calculations.

It is commonly recognized, but not customarily stated in health program discussions, that mortality can be both bane and blessing from the socioeconomic standpoint. Excessive mortality, when defined by astutely selected epidemiologic criteria, is a relevant program planning factor. However, excessive mortality requires considerable study before it can be applied to program development for comprehensive health services to groups such as the Indians and Alaska Natives. Ratios, such as we have set up in this study, which compare the mortality among the minority with that of the reference group, may be a starting point in a study of the relative roles of morbidity and mortality considerations in health program planning for Indians and Alaska Natives.

Summary and Conclusions

A comparison was made of the utility and relevance of using data on mortality, hospitalization, physician visits, and restricted activity (disability), as well as computations of time loss and indirect economic cost caused by these factors, in the appraisal of health needs of and the development of comprehensive health care programs for Indians and Alaska Natives. The overall objective of the study was to develop statistical approaches for linking measures of health status of a population and for computing indices of social and economic impact of disease. The experience afforded by this study led to the following general conclusions:

- While the quality and quantity of data on health status and on utilization of health services has grown and improved continually in recent years, diversity of classification and disparity of precision in the reporting of these data cause considerable difficulty in linking sets of data and in integrating those data into computations of measures of social and economic cost.
- The weight commonly accorded to the impact of mortality on the health, social, and economic status of the general population, or of an analogous age-sex subgroup, requires philosophical and ecological reappraisal which includes consideration of both positive and negative effects.
- Both mortality and morbidity data can be translated into measures of social and economic impact when expressed in terms of time lost from the social and economic activities of living.
- Calculation of time loss due to morbidity and mortality at present appears to be the best available statistical approach to measure social impact and to judge the economic implication of disease occurring among a population comprised of all age-sex groups.
- Indirect economic cost caused by both morbidity and mortality can be calculated only for that portion of a general population which is in the work force; consequently, indirect economic cost has limited utility in the justification, planning, and evaluation of comprehensive programs of health services.

The study was concerned primarily with health status and socioeconomic impact of disease among a disadvantaged minority group, Indians and Alaska Natives. In this context, the following conclusions were reached:

- To be relevant, statements of health or socioeconomic status of disadvantaged, minority groups must be made in comparison with the general population or a more advantaged group; therefore, because of disparity in size or constitution of the population groups involved, the statements must be made in terms of rates, employing equivalent criteria of reference.
- Evaluations of indirect economic cost of disease at present are of dubious value in quantitating epidemiologic or social effects because of (*a*) the dynamic nature of current social change, and (*b*) the great disparity in current economic opportunity which, when applied to health data by standard health economic procedures, merely tends to obfuscate an epidemiologic statement of health disadvantagement.

The basic statistical objective of the study was to compare the health status of Indians and Alaska Natives with that of the general popula-

tion (all races). The data and comparisons showed a large health deficit for the Indians and Alaska Natives in relation to the status of all races. Thus, a need is indicated for continued improvement in the quality and quantity of health services provided to these disadvantaged people.

REFERENCES

(1) Rice, D. P.: Estimating the cost of illness. Health Economics Series No. 6. PHS Publication No. 947-6. U.S. Government Printing Office, Washington, D.C., May 1966.

(2) Rice, D. P., and Cooper, B. S.: The economic value of human life. Amer J Public Health 57: 1954–1966, November 1967.

(3) U.S. Public Health Service: Eighth revision international classification of diseases, adapted for use in the United States. PHS Publication No. 1693. U.S. Government Printing Office, Washington, D.C., 1967.

(4) Indian Health Service, Public Health Service: Indian and Alaska Native vital statistics, 1965. Office of Statistics and Analysis, administrative report, 1966.

(5) National Center for Health Statistics: Vital statistics of the United States, 1965. Vol. 2. Mortality, pt. A. U.S. Government Printing Office, Washington, D.C., 1967.

(6) Mushkin, S. J., and Collings, F. d'A.: Economic costs of diseases and injury. A review of concepts. Public Health Rep 74: 795–809, September 1959.

(7) Commission on Professional and Hospital Activities: Length of stay in short-term general hospitals (1963–1964). Blakiston Division, McGraw-Hill Book Company, 1966.

(8) National Center for Health Statistics: Persons hospitalized, by number of hospital episodes and days in a year, United States, July 1965–June 1966. PHS Publication No. 1000, Ser. 10, No. 50. U.S. Government Printing Office, Washington, D.C., February 1969.

(9) National Center for Health Statistics: Hospital discharges and length of stay: short-stay hospitals, United States, July 1963–June 1964. PHS Publication No. 1000, Ser. 10, No. 30. U.S. Government Printing Office, Washington, D.C., June 1966.

(10) National Center for Health Statistics: Patients discharged from short-stay hospitals. United States, October–December 1964. PHS Publication No. 1000, Ser. 13, No. 1. U.S. Government Printing Office, Washington, D.C., October 1966.

(11) Indian Health Service, Public Health Service: Division of Indian Health discharge summary, fiscal year 1966. Office of Statistics and Analysis, administrative report.

(12) National Disease and Therapeutic Index: Leading diagnosis and reasons for patient visits: No. 21. January 1965–December 1965; No. 23, July 1965–June 1966; No. 25, January 1966–December 1966. Lea and Associates, Ambler, Pa.

(13) National Center for Health Statistics: Volume of physician visits, United States, July 1966–June 1967. PHS Publication No. 1000, Ser. 10, No. 49. U.S. Government Printing Office, Washington, D.C., November 1968.

(14) Indian Health Service, Public Health Service: Outpatient information pilot study: estimated 10 percent survey, DIH fixed facilities, 1965–66. U.S. Government Printing Office, Washington, D.C.

(15) National Center for Health Statistics: Chronic conditions causing activity limitation: United States, July 1963–June 1965. PHS Publication No. 1000, Ser. 10, No. 51. U.S. Government Printing Office. Washington, D.C., February 1969.

(16) National Center for Health Statistics: Current estimates from the Health Interview Survey: United States, July 1965–June 1966. PHS Publication No. 1000, Ser. 10, No. 37. U.S. Government Printing Office, Washington, D.C., May 1967.

(17) National Center for Health Statistics: Disability days, United States, July 1965–June 1966. PHS Publication No. 1000, Ser. 10, No. 47. U.S. Government Printing Office, Washington, D.C., October 1968.

(18) U.S. Bureau of the Census: Non-white population by race: economic characteristics of the Indian population. U.S. Census of Population, vol. 2, table 56. U.S. Government Printing Office, Washington, D.C., 1960.

(19) U.S. Bureau of the Census: Consumer income. Current Population Reports, Series P–60, No. 50. U.S. Government Printing Office, Washington, D.C., Aug. 26, 1966.

Tearsheet Requests

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