

efforts to reduce the costs of chronic dialysis therapy and to improve immunosuppression and organ matching techniques will be intensified. It is estimated that an additional \$700,000 will be expended by voluntary health agencies in dialysis and transplant research.

#### 5. Training

HEW training expenditures for basic and on-the-job education for staff to work in dialysis and transplant therapy will increase to about \$5,500,000 to measure up to the additional needs. No other expenditures in this area are anticipated from outside sources.

#### 6. Facilities

HEW facility expenditures are expected to increase to about \$2,500,000 with outside funding estimated to be about \$800,000. This increase reflects the need for additional facilities for treatment of end-stage uremia patients.

#### 7. Summary

HEW expenditures for this program are estimated to be about \$56,000,000 with total program expenditures estimated at about \$71,000,000. Total benefits in terms of reduction in mortality derived from the program are about 1,560 lives of which 1,060 can be attributed to HEW funding.

A summary of the benefits and costs of this program is presented in Table XIV.

Table XIV

END-STAGE UREMIA, HYPOTHETICAL PROGRAM  
 AT INTERMEDIATE HEW EXPENDITURE LEVEL, BASED ON THE CURRENT STATE OF THE ART

Program			Short-Term Benefits	
	Expenditures		Reduction in Mortality for 1966	
	HEW (\$ 1,000)	Total (\$ 1,000)	HEW Program (No. of Lives)	Total Program (No. of Lives)
Dialysis	11,000	21,000	704	1,144
Transplant	19,000	22,200	356	416
Research	18,000	18,700		
Training	5,500	5,500		
Facilities	2,500	3,300		
	56,000	70,700	1,060	1,560

D. End-Stage Uremia, Hypothetical Program at an Accelerated HEW Expenditure Level, Based on Current State of the Art

1. Introduction

This program describes what could be accomplished in an end-stage uremia program with a funding level about 10 times that of the current program and with no changes in the state of the art, that is, assuming no significant technological or research advances. There are five program components including:

- 1) Dialysis treatment;
- 2) Transplantation treatment;
- 3) Research;
- 4) Training; and
- 5) Facilities.

The costs of this accelerated HEW program will be approximately ten times the cost of the current program, or about \$210,000,000. Total program costs will be approximately \$230,000,000 and take into account expenditures by other federal agencies and the private sector of the economy. Figure 16 graphically presents the costs of the accelerated kidney disease program assuming the current state of the art. Based on the nature of the two specific types of treatment, their results, the nature of the patient population available, and time and facility requirements, the assumption is made that about 30% of the patients will be treated by chronic dialysis therapy and the remainder by a transplant-dialysis therapy program. Descriptions of specific components of the total program and their associated benefits follow.

(\$1,000,000)

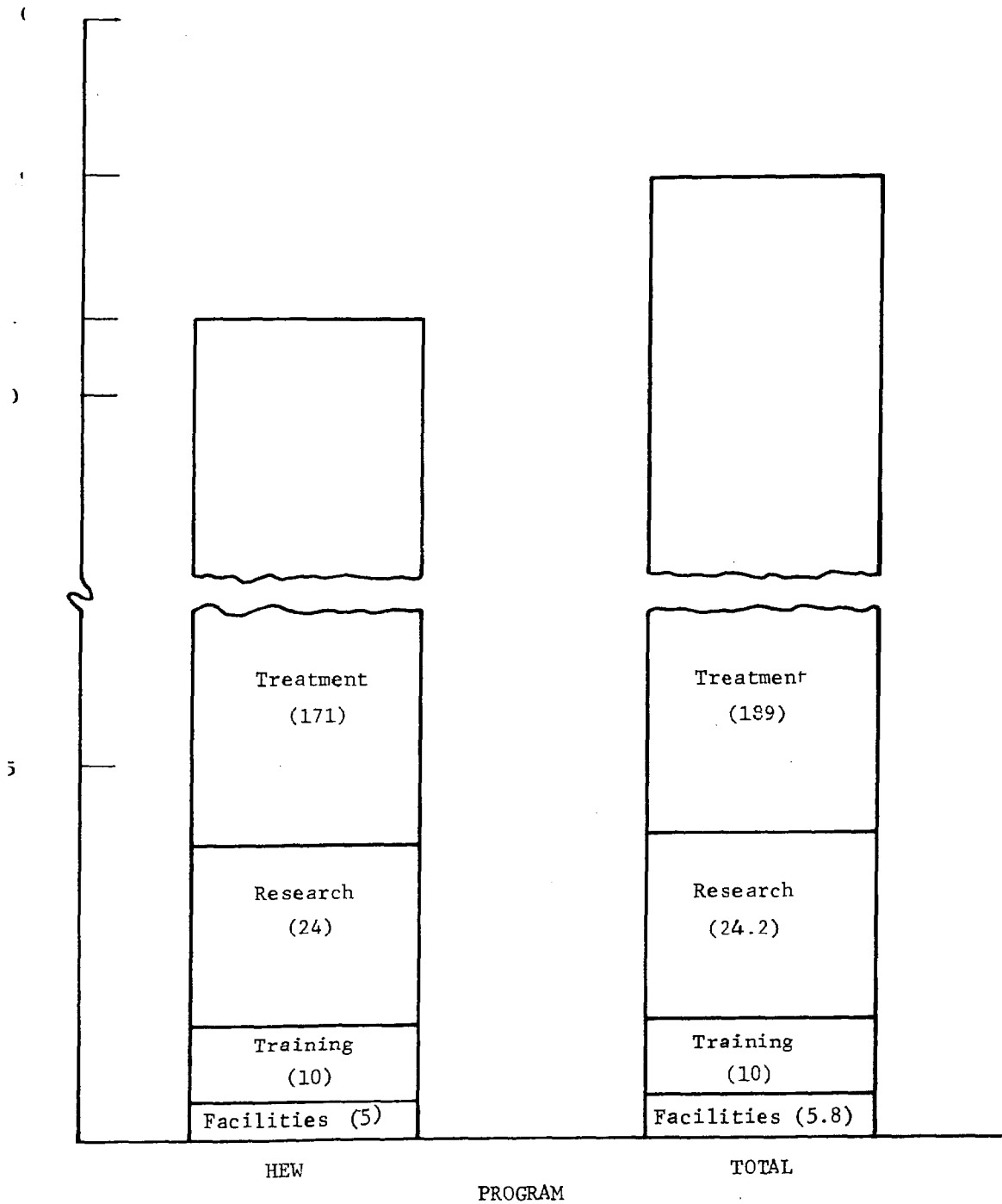


Fig. 16. End-Stage Uremia, Hypothetical Program Costs at Accelerated HEW Expenditure Level, Based on the Current State of the Art.

## 2. Dialysis Program

A total of about 5,100 patients will undergo chronic dialysis therapy; 4,500 of these can be attributed to HEW funding. It is estimated that the Veterans Administration is now treating about 225 patients and that the cost of 350 patients is borne by private and other sources.

Under the circumstances of greater efficiency associated with mass treatment, it is assumed that dialysis costs have decreased to \$10,000 per year per patient. HEW expenditures for dialysis treatment total approximately \$45,000,000. As indicated above, it is assumed that because of the availability of HEW money, private and VA funding for dialysis will not change materially. The total costs for dialysis treatment are now estimated at approximately \$55,000,000.

It is assumed that the overall annual mortality of 20% among dialysis patients has not changed. Applying this mortality factor to the patients undergoing therapy, it can be surmised that 3,600 lives will be prolonged by HEW funds. The benefits associated with the total program are about 4,100 lives prolonged. As indicated previously, these benefits are anticipated during the first year the program is in effect.

## 3. Transplant Program

Because of the availability of funds about 11,000 patients will now be treated on an annual basis. Of these, approximately 10,500 are attributed to HEW funding.

Under circumstances of more efficient mass treatment and utilization of facilities an assumption is made that transplant costs per patient have decreased from \$16,000 to \$12,000. Transplant costs for individual non-HEW supported patients will remain at about \$16,000. HEW expenditures in support of transplantation treatment now total approximately \$126,000,000. Total expenditures in support of transplantation treatment are approximately \$134,000,000.

It is assumed that the mortality among the transplantees will be decreased from 40% to about 35% due to the improved kidney:patient matching which is possible under circumstances of a large program. Among the 65% who survive about one-half are cured; the remainder return to chronic dialysis therapy or adjunctive dialysis pending retransplantation

The number of patients cured as a result of the accelerated transplant program is 3,575 of which 3,412 can be attributed to HEW support.

#### 4. Research

While no specific research plans will be outlined, it is assumed that HEW research expenditures have increased to a total of about \$24,700,000 in order to provide support for accelerated laboratory and clinical research in dialysis and transplantation. Non-HEW research expenditures primarily from voluntary health agencies are expected to be slight in comparison, i.e., approximately \$700,000.

#### 5. Training

HEW training costs will increase to about \$10,000,000 to provide the necessary training and experience for support of professional personnel involved in dialysis and transplant therapy. This training

will range from formal education in the form of postgraduate fellowships to on-the-job training. It is estimated that HEW expenditures will reflect the total costs in the area of training.

#### 6. Facilities

Facility expenditures by HEW will increase to \$5,000,000 and will be used to aid in the construction of new treatment facilities and expansion and modification of existing treatment facilities. Non-HEW expenditures for facilities are expected to be no more than \$800,000.

#### 7. Summary

HEW expenditures for the entire program are about \$210,000,000 with total costs estimated at \$230,000,000. It is estimated that the total program benefits in terms of mortality avoided will be 7,675 lives saved of which about 7,000 can be attributed to HEW funding. A total of about 16,000 patients can be treated under this program. Of these, about 4,900 will die as a combined result of either treatment. Of those surviving, about 3,600 are cured of kidney disease; because of transplantation, and about 4,100 are being maintained on chronic dialysis.

A summary of the benefits and costs of the program are presented in Table XV.

Table XV

END-STAGE UREMIA, HYPOTHETICAL PROGRAM  
 AT ACCELERATED HEW EXPENDITURE LEVEL, BASED ON THE CURRENT STATE OF THE ART

Programs	Expenditures		Short-Term Benefits	
			Reduction in Mortality for 1966	
	HEW (\$ 1,000)	Total (\$ 1,000)	HEW Program (No. of Lives)	Total Program (No. of Lives)
Dialysis	45,000	55,375	3,600	4,100
Transplant	126,000	134,000	3,412	3,575
Research	24,000	24,700		
Training	10,000	10,000		
Facilities	5,000	5,800		
Totals	210,000	229,875	7,012	7,675



E. End-Stage Uremia, Hypothetical Program for 1975, Accelerated Funding Level and Advanced State of the Art

1. Introduction

This program has five components consisting of:

- 1) Treatment by dialysis,
- 2) Treatment by transplantation,
- 3) Research,
- 4) Training, and
- 5) Facilities.

This program assumes that a number of advances have been made in the state of the art in dialysis and transplantation (see below). It is also assumed that progress in research and development in the primary kidney disease areas has not reduced the annual number of uremic deaths significantly because of implementation lag time. The major emphasis in this program is on transplantation since this procedure requires only a single treatment, thus about 60% of all patients are being transplanted. Total program costs are approximately \$162,000,000 of which about \$149,000,000 is being expended by HEW. A summary of program costs is presented graphically in Figure 17. A discussion of the various program components follows.

2. Dialysis Treatment

It is assumed that a simplified dialysis treatment has been developed which can be performed by the patient essentially independent of hospital or clinic facilities. Because of advances in the state of the art, the debilitating side effects of dialysis therapy have been largely eliminated. It is estimated that the annual overall mortality among chronic dialysis patients has been reduced to 5%. A total of about 12,000 patients are

Costs (\$1,000,000)

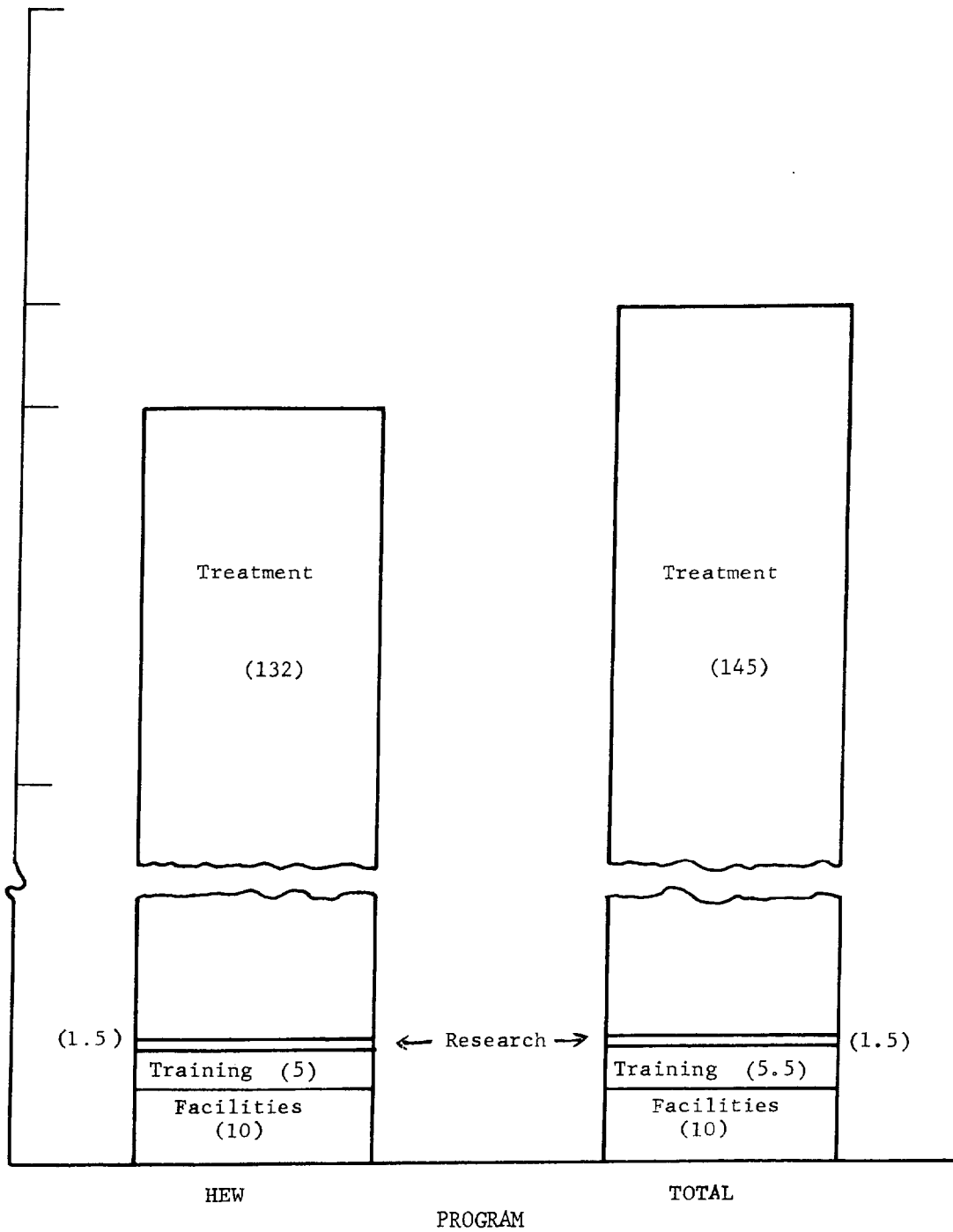


Fig. 17. End-Stage Uremia, Hypothetical Program Costs for Fiscal Year 1975, At Accelerated HEW Expenditure Level, Based on Expected Advanced State of the Art in 1975.

now being treated. Because of the availability of ample HEW funds only about 650 patients are being supported by other (VA and private) funds. The majority of these patients are "carry-overs" from previous years.

The cost to HEW and VA for maintaining dialysis patients has decreased to an absolute minimum of about \$3,000 per patient per year largely due to advances in technology and supplies, including disposable materials. Costs for private patients are estimated to be about \$5,000 annually. About \$34,000,000 will be expended by HEW for dialysis treatment during the first year this program is in effect. Total costs for dialysis treatment are estimated to be about \$37,000,000.

The total mortality avoided (lives prolonged) as a result of this program is about 11,400 of which some 10,800 can be attributed to HEW funding. Please note that these benefits are only for the first year that the program is in effect.

### 3. Transplant Treatment

Because of advances in the state of the art, the transplant program encompasses a highly effective organ matching and organ preservation system. Immunosuppressive techniques have become highly developed and successful. The procedure can now be carried out in most of the general hospitals in the United States. Overall annual survival among transplantees has increased from 65 to 90% and it is assumed that all survivors of the transplant procedure are cured. A total of about 17,750 kidney transplant procedures are being performed annually of which HEW supports about 16,350.

The cost of total patient management by transplantation within Federal programs has been reduced to about \$6,000 because of easier matching of organs, a decrease in graft-rejection reactions, and a decreased need for adjunctive dialysis. Non-Federal transplantation costs are about \$8,000 per patient.

The number of patients cured due to the total transplant program efforts is approximately 16,000 of which about 15,000 can be attributed to HEW funding.

#### 4. Research

Because of previous research achievements, HEW research expenditures have decreased considerably to an annual level of \$1,500,000. It is anticipated that there will be no support for research by other sources.

#### 5. Training

HEW training expenditures are estimated to be \$5,000,000 to provide for the necessary professional and allied personnel required in the treatment program. It is anticipated that because of the availability of HEW funds, there will be no expenditures from other sources for training.

#### 6. Facilities

Facilities expenditures are estimated to be \$10,000,000 and are used in establishing or maintaining the complex of treatment facilities required for this program. An additional \$800,000 is estimated to be spent by other sources.

#### 7. Summary

HEW expenditures for this program are estimated at about \$148,000,000. Total program costs are estimated to be about \$102,000,000. Total mortality

avoided because of this program will be about 27,000 lives of which about 26,000 will be attributed to HEW.

The above program sustains about 11,400 dialysis patients and about 16,000 transplantees during the first year the program goes into effect. The majority of the dialysis patients (about 90%) would be carry-over patients from previous years. These patients include transplant rejects as well as uremic patients unsuitable for transplantation.

A summary of the benefits and costs of this program is presented in Table XVI.

END-STAGE UREMIA, HYPOTHETICAL PROGRAM FOR FISCAL YEAR 1975  
 AT ACCELERATED HEW EXPENDITURE LEVEL, BASED ON EXPECTED ADVANCED STATE OF THE ART IN 1975

Programs	Expenditures		Short-Term Benefits	
			Reduction in Mortality for 1966	
	HEW (\$ 1,000)	Total (\$ 1,000)	HEW Program (No. of Lives)	Total Program (No. of Lives)
Dialysis	34,125	36,775	10,806	11,424
Transplant	98,100	108,100	14,715	15,975
Research	1,500	1,500		
Training	5,000	5,000		
Facilities	10,000	10,800		
Totals	148,725	162,175	25,521	27,399

## REFERENCES AND FOOTNOTES

1/ In 1964 there were 10,297 deaths recorded under ICD codes 600, 605, 607, and 640 (United States Department of Health, Education, and Welfare, Vital Statistics of the United States, Vol. II - Mortality Part A, Washington, D. C.: U. S. Government Printing Office, 1966, p. 1-68). The 1966 estimates were derived by multiplying the 1964 deaths by the ratio of the total United States population in 1966 versus 1964 (1.0246). Bureau of the Census, "Estimates of the Population of the United States by Age, Color, and Sex; July 1, 1960 to 1965," Population Estimates, Series P-25, No. 321, November 30, 1965, p. 11 and Bureau of the Census, "Estimates of the Population of the United States by Age, Color, and Sex; July 1, 1966," Population Estimates, Series P-25, No. 352, Nov. 18, 1966, p. 1.

2/ It is estimated from the Division of Health Interview Statistics, National Center for Health Statistics, U. S. Department of Health, Education, and Welfare, report (unpublished), that in fiscal year 1965 the civilian non-institutional population had an estimated prevalence of 1,933,000 cases of infectious diseases of the kidney with an associated 37,535,000 days of restricted activity (an average of 19 days per case), 17,012,000 days of bed disability, and 4,121,000 work-loss days.

In order to take into account population changes for 1965 to 1966, the above morbidity statistics were corrected by a factor of 1.0156. This reflects the increase in population--Bureau of the Census, "Estimates of the Population of the United States by Age, Color, and Sex; July 1, 1966," Population Estimates, Series P-25, No. 352 (November 18, 1966), p. 1 and Bureau of the Census, "Estimates of the Population of the United States by Age, Color, and Sex; July 1, 1960 to 1965," Population Estimates, Series P-25, No. 324, (November 11, 1965), p. 11.

The corrected statistics yielded an estimated prevalence of 1,963,000 with an associated 38,197,000 days of restricted activity, 17,277,000 days of bed disability, and 4,185,000 work-loss days.

3/ Edward H. Kass, "Asymptomatic Infections of the Urinary Tract," Transactions of the Association of American Physicians, Vol. 69, 1956, p. 56-64.

4/ Alan L. Kaitz, and Elizabeth J. Williams, "Bacteriuria and Urinary-Tract Infections in Hospitalized Patients," The New England Journal of Medicine, Vol. 262, No. 9, (March 3, 1960), pp. 425-430.

Edward H. Kass, "Bacteriuria and Pyelonephritis of Pregnancy," Archives of Internal Medicine, Vol. 105 (1960), pp. 257-264.

Ruth Osterby Hansen, "Bacteriuria in Diabetic and Non-Diabetic Out-Patients," Acta Medica Scandinavica, Vol. 176, No. 6 (1964), pp. 721-730.

5/ Admissions to non-federal long-term general hospitals, non-federal short-term general hospitals and federal general hospitals were used to derive the hospitalized population. In 1965 these totalled 28,184,957. Hospitals, Vol. 40, Part 2 (August 1, 1966), p. 442.

In order to take into account population changes and to provide estimates for 1966, we corrected the 1965 hospital admissions by a factor of 1.56% (see Footnote 2 above) for a total of 28,625,000.

The resident population in nursing homes was derived from National Center for Health Statistics, "Characteristics of Residents in Institutions for the Aged and Chronically Ill in United States, April-June 1963," Vital and Health Statistics, Series 12, No. 2, p. 19, and amounted to 505,242 residents in 1963.

The Nursing Home population was corrected for increases in the population 65 years and over from 1963 to 1966 by a factor of 3.37% (the sources for this factor are the same as the ones described above for the hospital admissions). The new estimate is 522,000 residents in nursing homes.

The total relevant population for 1966 is estimated at 29,147,000.

6/ The number of pregnant females for fiscal year 1965 was taken from National Center of Health Statistics, "Current Estimates from the National Health Interview Survey, United States, July 1964 - June 1965," Vital and Health Statistics, Series 10, No. 25, November 1965, p. 5. The published number of 4,472,000 was corrected for the increase in population for females between 20 and 45 years of age. The correction factor was .57% (Bureau of the Census, "Estimates of the Population of the United States by Age, Color, and Sex; July 1, 1966," Population Estimates, Series P-25 No. 352 (November 18, 1966), p. 15, Bureau of the Census, "Estimates of the Population of the United States by Age, Color, and Sex; July 1, 1960-1965," Population Estimates, Series P-25, No. 324 (November 11, 1965), p. 11. The new estimate is 4,497,000.

7/ The estimated number of non-hospitalized diabetics was obtained from unpublished data from the National Center of Health Statistics. The unpublished estimates showed a prevalence of 2,385,000. Taking into the account the increase in population from 1965 to 1966 of 1.56% (see Footnote 2) we arrived at a new estimate of 2,422,000.

8/ See Footnote 4.

9/ 36,066,000 individuals divided by 6,462,520 cases of significant bacteriuria.

10/ Based on informed medical judgment.

11/ The estimate of 5% false positives was based on informed medical judgment.

12/ A "best estimate."



- 13/ 36,066,000 individuals in the target population times \$0.25.
- 14/ Based on patient charges from Duke University Hospital, Durham, N.C.
- 15/ A "best estimate."
- 16/ A "best estimate."
- 17/ It was felt that 65% of the deaths could be attributed to the relevant population, or 6,800 from a base of 10,550 (see Footnote 1).
- 18/ Based on informed medical judgment.
- 19/ It is estimated that of the 19 average morbid days per individual (see Footnote 2), only 20% should be attributed to infections of the kidney because all of the high-risk groups have other primary diagnoses. The prevalence was multiplied by 19 days and then corrected by the 20% factor.
- 19A/ The specific relationship between infections of the urinary tract and end-stage kidney disease due to chronic pyelonephritis is still subject to conjecture. The estimates made here are based on the assumption of a cause and effect relationship between bacteriuria and chronic pyelonephritis.
- 20/ Based on informed medical judgment.
- 21/ Based on informed medical judgment.
- 22/ All the estimates in this paragraph were based on informed medical judgment.
- 23/ A "best estimate."
- 24/ A "best estimate."
- 25/ A "best estimate."
- 26/ Based on informed medical judgment.
- 27/ Bureau of the Census, "Estimates of the Population of the United States by Age, Color, and Sex, July 1, 1966," Population Estimates, Series P-25 No. 352 (November 18, 1966), p. 17.
- 28/ A "best estimate."
- 29/ C. Kunin, T. Southall, and A. J. Paquin, "Epidemiology of Urinary-Tract Infections. A Pilot Study of 3,057 School Children," New England Journal of Medicine, Vol. 203 (1960), p. 817.
- 30/ A "best estimate."
- 31/ The prevalence base used is the one derived from the 1% or 25,200 detected cases with significant bacteriuria among females 6 to 9 years of age.
- 32/ See Footnote 19.

- 33/ Based on informed medical judgment.
- 34/ Based on informed medical judgment.
- 35/ The estimated total number of detected cases of significant bacteriuria in the 6 to 9 years of age female group.
- 36/ Based on informed medical judgment.
- 37/ Based on informed medical judgment.
- 38/ See Footnote 27.
- 39/ S. Switzer, "Bacteriuria in a Healthy Population and Its Relation to Hypertension and Pyelonephritis," New England Journal of Medicine, Vol. 264 (1961), p. 7.
- 40/ Since 12,319,500 are expected to be screened each year and 1% or 123,195 are estimated to have significant bacteriuria, then if 85% (104,716) will be detected, 109,952 (104,716 x 105%) will show a positive screening test result.
- 41/ It was felt that about 60% of the 41,065 females 21 years of age and under can be reached. Of these 24,639,000 females, the screening program would reach one-half each year or 12,319,500. One percent of these or 123,195 would have bacteriuria.
- 42/ From a prevalence base of 123,195, 2,340,710 morbid days were calculated by using an average of 19 morbid days per individual (unpublished data from National Center of Health Statistics).
- 43/ Based on informed medical judgment.
- 44/ Based on informed medical judgment.
- 45/ Based on informed medical judgment.
- 46/ Based on informed medical judgment.
- 47/ Bureau of the Census, "Estimates of the Population of the United States by Age, Color, and Sex; July 1, 1960 to 1965," Population Estimates, Series P-25, No. 352 (November 18, 1966), p. 1, and Bureau of the Census, "Projections of the Population of the United States by Age, Sex and Color to 1990, with Extensions of Total Population to 2015," Population Estimates, Series P-25, No. 359 (February 20, 1967), p. 14.
- 48/ See Footnote 4.
- 49/ See Footnote 4.
- 50/ See Footnote 4.
- 51/ See Footnote 39.

- 52/ These include all high-risk groups adjusted for population changes.
- 53/ A "best estimate."
- 54/ Based on informed medical judgment.
- 55/ Based on informed medical judgment.
- 56/ Based on informed medical judgment.
- 57/ Based on informed medical judgment.
- 58/ Based on informed medical judgment.
- 59/ Based on informed medical judgment.
- 60/ Based on informed medical judgment.
- 61/ In 1964 there were 12,414 deaths recorded under ICD codes 590-594 (U. S. Department of Health, Education, and Welfare, Vital Statistics of the United States, Vol. II - Mortality Part A, Washington, D. C.: U. S. Government Printing Office, 1966, pp. 1-68). The 1966 estimates were derived by multiplying the 1964 deaths by the ratio of the total United States population in 1966 versus 1964 (1.0246).  
(See Footnote 1.)
- 62/ It is estimated based on data from the Division of Health Interview Statistics, National Center for Health Statistics, U. S. Department of Health, Education, and Welfare report (unpublished), that in fiscal year 1965 the civilian non-institutional population had an estimated prevalence of 104,000 cases of hypersensitivity diseases of the kidney with an associated 4,011,000 days of restricted activity (an average of 40 days per case), 1,806,000 days of bed disability, and 765,000 work-loss days. Taking into account the population increase from 1965 to 1966 (correction factor of 1.0156; see Footnote 2), the prevalence is estimated at 106,000 with an associated 4,074,000 days of restricted activity and 1,834,000 days bed disability as well as 777,000 work-loss days.
- 63/ See Footnote 61.
- 64/ A "best estimate."
- 65/ Based on informed medical judgment.
- 66/ Based on informed medical judgment.
- 67/ Estimated from unpublished data from the National Center for Health Statistics.
- 68/ Based on informed medical judgment.

- 69/ Based on informed medical judgment.
- 70/ Based on informed medical judgment.
- 71/ Based on informed medical judgment.
- 72/ Based on informed medical judgment.
- 73/ John I. Levit, "The Prognostic Significance of Proteinuria in Young College Students." Annals of Internal Medicine, Vol. 66, No. 4, (April 1967), pp. 685-698, and Maurice B. Strauss and Louis G. Welt, ed., Diseases of the Kidney, Boston: Little, Brown and Company, 1963, pp. 80-88.
- 74/ Ibid.
- 75/ Ibid.
- 76/ Ibid.
- 77/ The estimate of 1966 deaths of 12,719 (see Footnote 61), was corrected by the change in population factor of 1.14% (see Footnote 46).
- 78/ Based on informed medical judgment.
- 79/ The 20,000 cases with hypersensitivity diseases were multiplied by 40 morbid days (unpublished data from the National Center for Health Statistics) to arrive at 800,000 morbid days.
- 80/ Based on informed medical judgment.
- 81/ Based on informed medical judgment.
- 82/ See Footnote 47.
- 83/ Maurice B. Strauss and Louis G. Welt, ed., Diseases of the Kidney, Boston: Little Brown, and Company, 1963, p. 505.
- 84/ In 1964 there were 69,634 deaths recorded under ICD codes 440-447 (U. S. Department of Health, Education, and Welfare, Vital Statistics of the United States, Vol. II - Mortality Part A, Washington, D. C.: U. S. Government Printing Office (1966), pp. 1-68). The 1966 estimates were derived by multiplying the 1964 deaths by the ratio of the total United States population in 1966 versus 1964 (1.0246). (See Footnote 1.)
- 85/ Based on informed medical judgment.

- 86/ It is estimated based on data from the Division of Health Interview Statistics, National Center for Health Statistics, U. S. Department of Health, Education, and Welfare report (unpublished), that in fiscal year 1965 the civilian non-institutional population had an estimated prevalence of 9,187,000 cases of hypertension with an associated 147,126,000 days of restricted activity (an average of 16 days per case), 54,638,000 days of bed disability (an average of 6 days per case), and 7,948,000 work-loss days (an average of 1 day per case). Taking into account the population increase from 1965 to 1966 of 1.0156 (see Footnote 2), the prevalence is estimated at 9,330,000 in 1966. To this is added an estimated 2,100,000 cases which are undiagnosed for a total of 11,430,000 hypertensives in 1966. Applying the same correction factors to the different classifications of morbid days and taking into account the undiagnosed cases, estimates of 181,280,000 days of restricted activity, 68,580,000 days of bed disability and 11,330,000 work-loss days are derived.
- 87/ H. Brainerd, et al., Current Diagnosis and Treatment, Los Altos, Calif.: Lange Medical Publication, 1966, p. 201.
- Paul B. Beeson, and Walsh McDermot, Textbook of Medicine, Philadelphia: W. B. Saunders Co., 1963, p. 712.
- 88/ It is estimated that 20% of the costs of curing those currently curable hypertensives who have renal complications (50% of these hypertensives) is attributable to renal causes, or 10% of the total cost.
- 89/ A "best estimate."
- 90/ Twenty percent of the 85% (7,930,000) with currently non-curable hypertension.
- 91/ It is estimated that 20% of the costs of curing those currently non-curable hypertensives who have renal complications (27% of these hypertensives) is attributable to renal causes, or 6% of the total cost.
- 92/ See Chapter 6, Section B.a.
- 93/ Based on informed medical judgment.
- 94/ Since only .8% of the hypertensives are being considered it is assumed that they would account for .8% of the hypertensive deaths in 1966 or 570.
- 95/ Based on informed medical judgment.
- 96/ Estimated from unpublished data from the Division of Health Interview Statistics, National Center for Health Statistics, U. S. Department of Health, Education, and Welfare.
- 97/ Based on informed medical judgment.

- 98/ Since approximately 70% of the hypertensives are being considered in this group, it is assumed that these would account for 70% of the estimated deaths in 1966, or 49,940.
- 99/ Morbid days were obtained by multiplying the affected prevalence of 1,586,000 (see Footnote 86) by 16 days, the average number of days of restricted activity for each case (see Footnote 84).
- 100/ It was assumed that the average remaining life span of each hypertensive was 20 years, Henry Brainerd, et al., op. cit., p. 207, and the expected cumulative number of cases of end-stage uremia, 98,000, see Chapter 6 Section B.2.c.(2), was divided by 20.
- 101/ Again, assuming that the average life span of hypertensives is 20 years, the expected number of cumulative cases of end-stage uremia, 277,550, see Chapter 6, Section B.2.c.(2), was divided by 20.
- 102/ Based on informed medical judgment.
- 103/ Based on informed medical judgment.
- 104/ These estimates are derived from the present level of effort in the renal hypertension program of NIH.
- 105/ These estimates are derived from the present level of effort in the renal hypertension program of NIH.
- 106/ These estimates are derived from the present level of effort in the renal hypertension program of NIH.
- 107/ Two-thirds of the population has been estimated to have seen a physician within a year prior to interview. (National Center for Health Statistics, "Age Patterns in Medical Care, Illness, and Disability, United States - July 1963 - June 1965," Vital and Health Statistics, Series 10, No. 32, June 1966, p. 12.) The estimated population of the United States in 1966, 17 years of age and over is 130,640,750. (Bureau of the Census, "Estimates of the Population of the United States, by Age, Color, and Sex: July 1, 1966," Population Estimates, Series P-25, No. 352, Nov. 18, 1966, p. 14.) Applying a factor of one-third to the population, we arrive at a rounded estimate of 43,500,000.
- 108/ Based on informed medical judgment.
- 109/ A "best estimate" taking into account intermediate program level budgetary constraints.
- 110/ Since approximately 0.2% of the total hypertensives is affected each year by this program sub-component, 0.2% of the 71,347 estimated deaths or 140 deaths are expected to occur yearly without the new program effort.

- 111/ Prevalence was derived by taking 15% (see Footnote 85) of the expected 175,000 newly detected hypertensives, or 26,250.
- 112/ The prevalence of 26,250 was multiplied by the average 16 days of restricted activity per case of hypertension (see Footnote 86).
- 113/ Since approximately 1.5% of the total hypertensives is affected by this program sub-component, 1.5% of the 71,347 estimated deaths, or 1,070 deaths are expected to occur yearly without the new program effort.
- 114/ The prevalence of 148,750 [85% (see Footnote 85) of the expected 175,000 newly detected hypertensives] was multiplied by the average 16 days of restricted activity per case of hypertension (see Footnote 86).
- 115/ Assuming that the average life span of hypertensives is 20 years, the expected number of cumulative cases of end-stage uremia, 11,025, (see Footnote 117), was divided by 20.
- 116/ Again, assuming that the average life-span of hypertensives is 20 years the expected number of cumulative cases of end-stage uremia, 31,240, was divided by 20.
- 117/ Seven percent, of the 157,500 (15% of the 1,050,000 newly detected hypertensives), or 11,025 patients with currently curable hypertension are estimated to progress eventually to end-stage uremia without this program sub-component.
- 118/ 3.5% of the 892,500 (85% of the 1,050,000 newly detected hypertensives), or 31,240 patients with currently non-curable hypertension are estimated to progress eventually to end-stage uremia without this program sub-component.
- 119/ Based on informed medical judgment.
- 120/ Since approximately 0.4% of all hypertensives are affected each year by this program sub-component, 0.4% of the 71,347 estimated deaths or 290 deaths are expected to occur yearly without this new program effort.
- 121/ The prevalence was derived by taking 15% (see Footnote 87) of the expected 350,000 newly detected hypertensives.
- 122/ The prevalence of 52,500 was multiplied by the average 16 days of restricted activity (see Footnote 86).
- 12 / Since approximately 3% of all hypertensives are affected each year by this program sub-component, 3% of the 71,347 estimated deaths, or 2,140 deaths are expected to occur yearly without this new program effort.
- 124/ The prevalence of 297,500 [85% (see Footnote 87) of the expected 350,000 newly detected hypertensives] was multiplied by the average 16 days of restricted activity per case of hypertension (see Footnote 86).

- 125/ The estimated population 17 years of age and over in 1975 is 150,554,000 (Bureau of the Census, "Projections of the Population of the United States by Age, Sex, and Color to 1990, with Extensions of Total Population to 2015," Population Estimates, Series P-25, No. 359, February 20, 1967, p. 14). The estimated population of 17 and over in 1966 is 129,746,000 (Bureau of the Census, "Estimates of the Population of the United States, by Age, Color, and Sex: July 1, 1966," Population Estimates, Series P-25, No. 352, November 18, 1966, p. 14). The ratio of the 1975 to 1966 population 17 years of age and over is 1.16.
- 126/ A "best estimate."
- 127/ It was assumed that approximately 30% of all hypertensives would have some associated renal problem and that 20% of their total treatment costs would be attributed to the treatment of the renal complication; therefore, 6% of \$10,997,000, or \$660,000, was attributed to renal complications.
- 128/ The vital statistics bases are derived in the same way as those in the 1966 accelerated program with the addition of 16% for anticipated increases in the population 17 years of age and over in 1975. Expected benefits take into account probable advances in the state of the art (see Chapter 6, Section E.6.).
- 129/ See Footnote 127.
- 130/ The benefits are the sum for all high-risk groups described and take into account 1) the 1975 population 17 years of age and over, and 2) the change in benefit rates due to advances in the control of the diseases discussed.
- 131/ The number of uremic deaths is based on conservative estimates from unpublished data gathered during a study conducted by the Research Triangle Institute, Research Triangle Park, North Carolina, entitled: Estimation of a Chronic Hemodialysis Population, March 1967.
- 132/ Ibid.
- 133/ The estimate of ideal transplant candidates was based on informed medical judgment.
- 134/ Unpublished data from the ongoing study, Socio-Economic Status of Dialysis Patients, Berkeley, California, University of California Medical Center.
- 135/ Ibid.
- 136/ U. S. Veterans Administration, unpublished data on Inpatient Mortality, Morbidity, and Treatment Costs, April 1967.



- 137/ B. H. Scribner, "Hemodialysis in the Treatment of Chronic Uremia," Abstracts, III International Congress of Nephrology, Vol. I: General Sessions--Symposia, Washington, D. C.: 1966, pp. 43-44.
- 138/ The total and HEW end-stage uremia programs costs for dialysis treatment were calculated on the basis of average annual costs of dialysis per patient.
- 139/ The dialysis-mortality estimate was based on informed medical judgment and unpublished data from the Kidney Disease Control Program, National Center for Chronic Disease Control.
- 140/ Public Health Service, U. S. Department of Health, Education, and Welfare, Kidney Diseases: 1968 Issue Paper and Appendices, Washington, D. C.: U. S. Government Printing Office, July 1966.
- 141/ Transplantation costs are based on informed medical judgment.
- 142/ The total and HEW end-stage uremia program costs for transplantation treatment are based on the average annual costs of transplantation per patient.
- 143/ Based on recent unpublished report "Fifth Report of the Human Kidney Transplant Registry," Department of Surgery, Harvard Medical School, the Peter Bent Bingham Hospital, the Massachusetts General Hospital, and the Harvard Computing Center.
- 144/ The transplant cure rate is based on informed medical judgment.
- 145/ Kidney Disease Issue Paper, op. cit.
- 146/ Training expenditures were based on unpublished data and expert opinion.
- 147/ Facility expenditures were based on unpublished data and expert opinion.

## Chapter 6

The Cost of Treating All Patients with Chronic Kidney Failure

## I. INTRODUCTION

Whenever consideration is given to the problem of kidney diseases, including end-stage kidney disease or progressive, ultimately fatal chronic renal failure, the question arises of the overall cost of treating all patients threatened by a uremic death, either with the aid of lifelong maintenance on dialysis or through an attempt at kidney transplantation whenever donor kidneys may be available. Although the original mission of the Kidney Disease Analysis Group did not include the preparation of an answer to this question it was felt that an analysis of this cost would be a natural corollary to the preceding analyses of costs and benefits of optimal programs aimed at the major primary kidney diseases and at end-stage kidney disease. In any consideration of possible programs for the amelioration of the kidney disease problem, the overall expense of treating all patients threatened with a uremic death regardless of the possible costs, for humanitarian reasons, represents one extreme in a broad spectrum of possible programs. It should therefore be ascertained to serve as a maximal bench mark for any intensive attempt at program analysis or planning.

II. APPROACH TO THE TOTAL TREATMENT OF END-STAGE  
KIDNEY DISEASEA. General Assumptions

In this particular hypothetical situation it is assumed that a population of 50,000 individuals exists who are threatened by death from end-stage

kidney disease during the first year of the projected program. It is known that approximately three-fourths of this population is above the age of 60. The available modes of treatment are primarily lifelong dialysis and transplantation.

For the purposes of this analysis an assumption is made that the change in population size during the following few years can be disregarded. Likewise this analysis assumes that any existing programs aimed at the amelioration of primary kidney diseases do not affect to a significant extent the figure of the vulnerable end-stage kidney disease population, at this point. This analysis assumes that there are no restraints on the availability of well-trained, competent physicians and other necessary personnel to administer the available treatments and on facilities needed for dialysis and transplantation. In reality such a "total push" program could not be undertaken all at once because of the above restraints, particularly because of the lack of sufficient qualified and willing physicians.

B. Treatment Modalities

1. Conservative Treatment

Conservative treatment, primarily by diet and symptomatic therapy will be reserved for a certain proportion of the vulnerable population, namely those extremely old and beset with other intercurrent complicating diseases which would make them unacceptable for major surgery and extremely poor risks for prolonged dialysis. (Also included in this list would be those individuals who, for a variety of other reasons are not suitable for chronic dialysis, or who refuse either treatment.) It is assumed that about 10,000 individuals out of the total vulnerable population of 50,000 belong in this category. A more conservative view may place the former figure at 15,000 to 20,000.

## 2. Transplantation

Projections for this treatment are based on the present state of the art. However, to make such a large-scale treatment program by transplantation possible at all it is assumed that efficient methods for collection of cadaver kidneys are in force and that existing legal barriers to tissue taking have been overcome. In addition, it is assumed that donation of kidneys upon death has become a popularly accepted procedure. In the subsequent calculation it is taken for granted that generally there will be no transplantation in patients over the age of 60 because of the highly increased operative risk and the many concurrent secondary disorders or complications found in this age group.

Of the 50,000 vulnerable patients, 10,000 will be treated by conservative means only (please see above). Of the remaining 40,000 candidates, 2,000 would meet ideal criteria for transplantation. Such criteria include not only optimal state of the patient's health (aside from his renal defect) but also the chances of optimal tissue matching with available kidneys. An additional 9,000 individuals would meet satisfactory criteria for transplantation.

In the group of ideal candidates it is expected that about 80 percent would be cured, and that approximately an additional 10 percent would survive but their transplanted kidneys would fail and they would require chronic dialysis for survival; an additional 10 percent would probably die directly due to the surgery or due to the sequelae of their operation or because of eventual immunosuppression therapy which makes them susceptible to overwhelming infections. In the group of satisfactory candidates the respective figures would be approximately

30 percent, 30 percent, and 40 percent.

On the average, it can be assumed that among the 11,000 patients in whom transplantation would be attempted, about 30 to 35 percent will be cured, an additional 30 to 35 percent would survive but would have to be returned to dialysis because of eventual failure of the transplanted kidney, and about 35 percent would die.

A small number of eventual secondary kidney failures may be expected among patients who were originally thought to be cured by transplantation. Most of these cases would probably represent development of glomerulonephritis in the transplanted kidney in patients in whom this disease was the original cause of renal failure. The assumption is made in the calculations to follow that these patients would be counted in the general reservoir of 50,000 vulnerable individuals who present themselves each year in need of treatment because of end-stage chronic kidney failure.

Based on the considerations and percentages mentioned above, of the 11,000 patients treated by transplantation each year, about 3,575 would be cured, an additional approximate 3,575 patients will have to be returned, eventually, to dialysis treatment, and approximately 3,850 will die during that year or soon thereafter.

### 3. Chronic Dialysis

Projections for this treatment are based on the current state of the art.

Of the 50,000 vulnerable patients, 10,000 will be treated by conservative means only, and of the remaining 40,000 candidates, 11,000 will be subject to transplantation (please see above). Thus, in any

one year there remain 29,000 patients who would be placed on chronic dialysis. In reality, conservative medical opinion may hold that many of these patients are not promising candidates for chronic dialysis. In addition there will be a group of about 3,575 patients each year who would be placed on chronic dialysis treatment because of eventual failure of their transplanted kidney (see above).

Among the large group of individuals who are candidates for chronic dialysis treatment there is a small group of highly suitable patients for dialysis. Based on current experience in the United States there is a yearly survival rate of 90 percent among such individuals on chronic dialysis. The majority of vulnerable individuals, however, cannot be considered good risks for chronic dialysis treatment under present conditions. At present, such patients would not be acceptable to the small number of existing dialysis programs in the United States. On the other hand, there has been considerable experience with such patients in many European centers who are accepting patients for chronic dialysis not on the basis of strict medical, psychological and socioeconomic admission criteria, but on the basis of patient need. The yearly survival rate for such patients is only about 50 percent during the first year and varies from 50 to 90 percent in subsequent years.

There is a great overlap in the groups which are considered ideal for transplantation and ideal for chronic dialysis and since transplantation will be attempted in those ideal or near-ideal for this purpose, the majority of patients in the chronic dialysis program will at best be satisfactory or high-risk patients. Based on the above considerations and percentages, the overall assumption was made that the survival rate in chronic dialysis for the first year of treatment will be 50 percent and that the survival rate in subsequent years among the remaining