Postrecovery Experience of Disabled-Worker Beneficiaries

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This article reports on the second phase of a longitudinal analysis of a 1972 cohort of newly entitled disabled-worker beneficiaries. The study focuses on the postrecovery experience of a sample of 1,713 Social Security disabled-worker beneficiaries whose Disability Insurance (DI) benefits were terminated because of a recovery. These individuals are observed from the time of the benefit termination until June 1986. The next event of interest is reentitlement (that is, return to the DI program), death, or retirement. The occurrence of one of these three events ends the postrecovery period. This study uses mathematical models to project events beyond the observation period and to calculate the proportions of those recovered beneficiaries who ultimately become reentitled, die, or retire. For those who become reentitled, the average time before returning to the DI program is estimated. These proportions and times are examined with respect to covariates such as the primary diagnosis of the disabling condition, primary insurance amount (PIA), educational level, previous occupation, sex, race, and age at recovery.

This study projects that about 43 percent of the beneficiaries who recover will end the postrecovery period by becoming reentitled to disabled-worker benefits, 5 percent will end this period with death, and 52 percent with retirement. About half of the 43 percent expected to become reentitled do so within the first 5 years after leaving the DI program rolls.

An examination of the covariates shows that the PIA has a strong effect on the reentitlement tendency. For persons in the high PIA group ($500 or more per month), it is projected that 65 percent will return to the program, compared with 34 percent in the low PIA group (less than $500). Those in the high PIA group also return to the program sooner than those in the low PIA group. The median lengths of time between termination based on recovery and reentitlement to the DI program are 3 years and 10 years, respectively.

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This article describes the postrecovery experience of individuals from a 1972 cohort of newly entitled Social Security disabled-worker beneficiaries whose Disability Insurance (DI) benefits were terminated due to recovery. Because work recoveries cannot be distinguished from medical recoveries in the data file, a recovery may be of either type. This article is a followup to the companion article in this issue [1]. Mathematical models are used to project events beyond the observation period and to calculate the proportions of recovered beneficiaries who die, retire, or become reentitled—that is, return to the DI program—as the next event of interest. For those who become reentitled to disabled-worker benefits, the average time elapsed before they return to the program is estimated. These proportions and times are examined using a set of covariates that include primary diagnosis of the disabling condition; primary insurance amount (PIA); educational level; type of past occupation and the demographic variables of sex, race, and age at recovery.

Information on the postrecovery experience of disabled-worker beneficiaries is of interest because it describes the probability of reentitlement to the DI program, the length of time from recovery to reentitlement, and the factors that influence the probability and the length of time. This study pioneers the collection and in-depth analysis of this kind of information. Along with the companion study, it is part of a larger project designed to measure changes in the length of time beneficiaries spend in the program by comparing the 1972 cohort with later cohorts.

Description of Data File

The 1,713 individuals analyzed in this study are former beneficiaries who recovered before January 1, 1981, and who were younger than age 62 at the time of recovery. The information is current to June 1986, except where otherwise noted. The Technical Appendix contains details of this data file.

Distribution of Covariates

Covariates such as sex, age, race, primary insurance amount (PIA), primary diagnosis, education, and occupation are shown in table 1. The following sections describe these covariates and their distribution in the sample.

Age, Sex, and Race

About 79 percent of the recovered beneficiary sample are male, and 87 percent are nonblack. At the time of recovery, 34 percent of the sample were younger than age 35; 38 percent were aged 35-49; and 28 percent were aged 50-61. Individuals aged 62 or older at the time of recovery are excluded because the available data do not distinguish between reentitlement to disabled-worker benefits and entitlement to early retired-worker benefits at age 62-64.

Primary Diagnosis

The diagnosis of the disabling condition is the primary underlying medical impairment on which the original entitlement decision in 1972 was based. As in the companion study [1], the diagnostic categories were taken from the International Classification of Diseases [2]. The diagnostic groups are

- Infective and parasitic diseases;
- Neoplasms;
- Mental disorders;
- Diseases of the—
  - nervous system and sense organs;
  - circulatory system;
  - respiratory system;
  - digestive system;
  - musculoskeletal system and connective tissue;
- Congenital anomalies;
- Accidents, poisoning, and violence; and
- Other

Because the sample sizes are small, the "other" group includes

Table 1.—Distribution of covariates, by primary insurance amount and age at recovery

Covariate	Primary insurance amount and age at recovery											
			Less than $500					$500 or more				
	Total number	Total percent	Number	Percent	18-34	35-49	50-61	Number	Percent	18-34	35-49	50-61
Diagnostic group												
Total	1,713	100.0	1,254	100.0	508	501	245	459	100.0	71	146	242
Infective	95	5.5	74	5.9	21	37	16	21	4.6	3	9	9
Neoplasms	42	2.5	21	1.7	6	5	10	21	4.6	2	4	15
Mental disorders	186	10.9	151	12.0	75	57	19	35	7.6	13	12	10
Nervous system	77	4.5	55	4.4	28	20	7	22	4.8	4	7	11
Circulatory	236	13.8	111	8.9	13	47	51	125	27.2	4	33	88
Respiratory	15	.9	8	.6	2	2	4	7	1.5	1	1	5
Digestive	42	2.5	33	2.6	10	15	8	9	2.0	1	3	5
Musculoskeletal	336	19.6	253	20.2	87	116	50	83	18.1	12	33	38
Congenital anomalies	38	2.2	33	2.6	17	14	2	5	1.1	2	1	2
Accidents	459	26.8	363	28.9	191	130	42	96	20.9	23	31	42
Other	187	10.9	152	12.1	58	58	36	35	7.6	6	12	17
Years of education												
Total	1,713	100.0	1,254	100.0	508	501	245	459	100.0	71	146	242
0-8	352	20.5	244	19.5	44	133	67	108	23.5	7	28	73
9-11	377	22.0	262	20.9	99	114	49	115	25.1	19	40	56
12	561	32.7	418	33.3	212	143	63	143	31.2	29	49	65
13 or more	234	13.7	171	13.6	90	53	28	63	13.7	11	19	33
Unknown	189	11.0	159	12.7	63	58	38	30	6.5	5	10	15
Sex												
Total	1,713	100.0	1,254	100.0	508	501	245	459	100.0	71	146	242
Men	1,347	78.6	936	74.6	422	378	136	411	89.5	63	136	212
Women	366	21.4	318	25.4	86	123	109	48	10.5	8	10	30
Occupation												
Total	1,713	100.0	1,254	100.0	508	501	245	459	100.0	71	146	242
White collar	370	21.6	262	20.9	96	102	64	108	23.5	11	35	62
Service	206	12.0	174	13.9	68	57	49	32	7.0	13	3	16
Farming	57	3.3	51	4.1	20	20	11	6	1.3	1	1	4
Manufacturing	513	29.9	352	28.1	152	150	50	161	35.1	19	64	78
Unknown and miscellaneous	567	33.1	415	33.1	172	172	71	152	33.1	27	43	82
Race												
Total	1,713	100.0	1,254	100.0	508	501	245	459	100.0	71	146	242
Nonblack	1,485	86.7	1,054	84.1	443	406	205	431	93.9	66	135	230
Black	228	13.3	200	15.9	65	95	40	28	6.1	5	11	12

diseases of blood and blood forming organs; diseases of the skin and subcutaneous tissue; endocrine, nutritional, and metabolic diseases and immunity disorders; diseases of the genitourinary system; and some additional diagnoses not belonging to these groups. In some analyses of these data, the groups are further combined.

Approximately 60 percent of these recovered beneficiaries became entitled on the basis of accidents, or musculoskeletal, or circulatory problems. The accidents group comprises the largest group of recovered beneficiaries (27 percent), followed by the musculoskeletal group (20 percent), and the circulatory group (14 percent).

Primary Insurance Amount

The PIA is the dollar figure on which cash benefits are based. It is a function of the number of years of covered earnings under the Social Security program before the onset of disability and the level of earnings for those years. It serves as a rough proxy for the level of lifetime earnings. The PIA also gives a rough indication of economic status because it is directly related to the cash benefits received.

The PIA in effect on December 31, 1985, is used in this analysis. The PIA is uniformly updated for all individuals on the Master Beneficiary Record (MBR) as legislative changes mandate. The 1985 PIA reflects adjustments made over the years in response to legislative changes and inflation. In the case of beneficiaries who recovered and became reentitled to disabled-worker benefits, the 1985 PIA might reflect earnings in the intervening period. Thus, the PIA used in this study is current.

The PIA was originally categorized into four levels: $1-$299; $300-$499; $500-$699; and $700 or more. In the initial analysis of the probability of reentitlement, similar tendencies were found in the two lowest PIA groups and in the two highest PIA groups. Thus, these four groups were recombined into two PIA groups: One group with a PIA less than $500 (low) and a group with a PIA greater than or equal to $500 (high).

Because the PIA is an important variable in the analysis, the distribution of other covariates in the low and high PIA groups was calculated using table 1. The two groups differ in the distribution of the other covariates.

Education

Recovered beneficiaries are classified according to educational level attained at the time of entitlement in 1972. Twenty-one percent went no higher than the eighth grade. Twenty-two percent completed grades 9-11; 33 percent have 12 years of education and graduated from high school; and 14 percent have some years of college. For 11 percent, educational attainment is unknown.

Occupation

For most persons in the sample, the occupation reported is the major occupation in the 15-year period preceding their application for disabled-worker benefits and entitlement in 1972. The Dictionary of Occupational Titles (DOT) 1965 codes [3] are used to coarsely group occupations into white collar (codes 1-29), service (codes 30-38), farming (codes 40-46), manufacturing (codes 50-89), or unknown and miscellaneous. Twenty-two percent of the beneficiaries in this study are classified white collar, 12 percent service, 3 percent farming, 30 percent manufacturing, and 33 percent miscellaneous or unknown.

Understanding the Postrecovery Process

To understand the analysis plan, it is necessary to have a conceptualization of the postrecovery process of the cohort being studied. These individuals take part in a process having one of three possible next events or outcomes after leaving the DI program because of recovery: Reentitlement under DI program, death, or attainment of age 62 and becoming eligible for early retired-worker benefits. This study refers to the last event as retirement. Attainment of age 62 rather than age 65 was chosen as a proxy for retirement for several reasons. First, because early retirement is now possible, a different mathematical formulation of the postrecovery process is necessary after age 62. Second, the data file did not distinguish between receipt of early retired-worker benefits or reentitlement to disabled-worker benefits. Therefore, a model of the postrecovery process only up to age 62 was developed.

Only the next event in the postrecovery process is examined. Everyone eventually dies, and those becoming reentitled may eventually retire. A recovered beneficiary is observed until one of these events occurs or until the conclusion of the observation period June 1, 1986.

The observation times of these recovered beneficiaries vary. For example, an individual who recovered in 1973 would be observed until one of the three events occurred (reentitlement, death, or retirement) or until June 1986. An individual recovering in 1978 might have a shorter observation time. The observation time begins at recovery and ends when one of the three outcomes occurs or June 1986.

The focus here is in predicting what percentage of these individuals ultimately become reentitled, die, or retire as their next event in the postrecovery process. If a long observation period after recovery is allowed, one of these outcomes would be eventually observed for each individual and the percentages for each outcome could be calculated directly. However, for about one-half of the individuals, none of the outcomes was observed within the stated timeframe. Thus, what was observed about the postrecovery process from all individuals was used to capture trends in the process and to make predictions regarding the ultimate percentages of those who would become reentitled, die, or retire as the next event after leaving the DI program.

This analysis can be based on covariates or characteristics of those in the study population and includes the standard demographic covariates of sex, race, and age, as well as the program relevant covariates of primary diagnosis, PIA, education, and occupation. Thus, questions relevant to policy formulation can be asked. Is the tendency of an individual to become reentitled under the DI program as the next event in the postrecovery period a function of these covariates? Is the probability of reentitlement a function of these covariates or characteristics?

In this study, before an individual attains age 62, the only outcomes of interest are reentitlement or death. The analytic approach begins by modeling the tendency for an individual either to become reentitled at a moment in time or to die at a moment in time. Demographic studies with death as the only outcome refer to this tendency as the force of mortality. These tendencies toward reentitlement and death compete with each other and the net result, in terms of the probability of next becoming reentitled or next dying, depends on their relative strengths. For example, recovered beneficiaries in the older age groups might exhibit a greater tendency to die, compared with those in the younger age groups. Older recovered beneficiaries may also exhibit a greater tendency to become reentitled. The proportion of older individuals who die or become reentitled as the next event in the postrecovery process depends, in part, on the relative strengths of these tendencies.

Another factor to consider, however, is the outcome of retirement. If an individual is close to age 62, a death or reentitlement may not be observed because the next event or outcome of interest may be retirement. It should be recalled that retirement is defined as attainment of age 62. Thus, even if tendencies to become reentitled or die are strong for those in the oldest age group, the probability of a reentitlement or death may not be high because individuals are close to retirement age and the most likely next event may be retirement.

Reentitlement Tendency

The tendency for recovered beneficiaries to become reentitled—that is, return to the DI program—over time can be described using mathematical models based on the observed experience of individuals in this study. Some of the highlights are described below. For details of the modeling process, see the Technical Appendix.

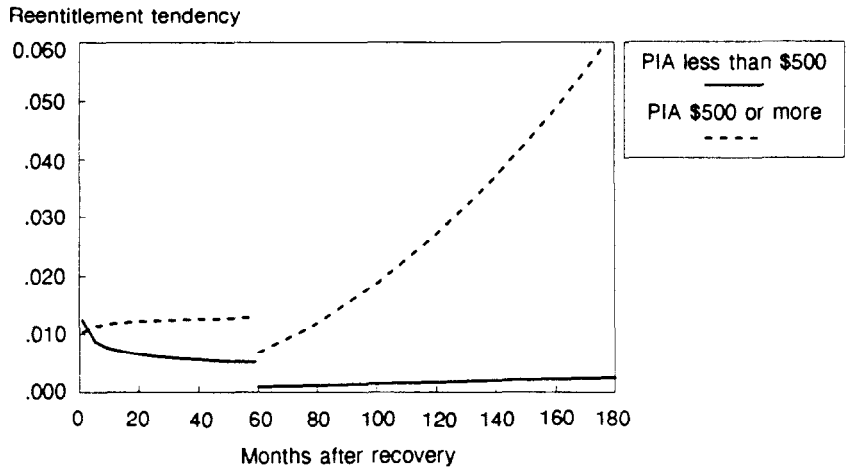
The tendency to return to the DI program is higher for persons in the high PIA group ($500 or more) compared with those in the low PIA group (less than $500). Because the tendency to return to the program is strongly dependent on the PIA, separate models were used for the low PIA group and high PIA group.

This study was not designed to explain exactly why those in the high PIA group show a greater tendency to return to the program. However, one possible explanation is that persons in the high PIA group, with their corresponding larger benefits, find the DI program financially attractive. Persons with higher PIA's may not be able to obtain jobs with relatively high earnings levels and thus find their untaxed disabled-worker benefit more attractive than earnings, which are taxable. It should be noted that a potentially important variable, severity of impairment, which might explain the effect of PIA on reentitlement, was not available in the data files or included in the analysis. Individuals in the high PIA group might have more severe impairments and, thus, exhibit a greater tendency to return to the program because of their more severe disabling condition.

The value of $500 was suggested by the data and was a means of

assigning individuals to a low or high PIA group. The cutoff point of $500 is not significant of itself, but rather is a means of indicating the fact that individuals in both groups appear to have different tendencies toward reentitlement. Because the tendencies toward reentitlement are different for the low and high PIA groups, the effects of the other covariates are described separately for each group. Additional covariates were important for the low PIA group. This difference is explained in the next section.

Chart 1.—Reentitlement tendencies for women aged 50-61 with less than 13 years education and not in the accidents group, by primary insurance amount



Low PIA Group

The solid line in chart 1 illustrates the estimated reentitlement tendency for a subgroup of the low PIA group. Their tendency to become reentitled decreases over time in the first 5 years after benefit termination and then drops abruptly at 5 years. In the period beyond 5 years after recovery, the tendency to become reentitled is lower but gradually increases.

To improve the quality of the model, it was necessary to divide the postrecovery period into two parts: The first 5 years after recovery and the time beyond the first 5 years of recovery. A possible rationale for dividing the postrecovery period is that the Social Security Amendments of 1960 eliminated the waiting period for cash benefits to a recovered beneficiary who is disabled within 5 years after the last DI benefit was received. In addition, the Social Security Disability Amendments of 1980 eliminated the 24-month waiting period for Medicare coverage for persons who become disabled a second time, if that worker becomes disabled again within 60 months or 5 years. Thus, possible incentives exist to return to the program in the first 5 years of the postrecovery period.

Sex.—In the first 5 years after recovery, women with a low PIA (19 percent of those in the study) show a greater tendency than do men to return to the DI program. Beyond 5 years after recovery, the tendency to return to the program does not differ for men and women with low PIA's.

Education.—Within the first 5 years after recovery, recovered beneficiaries in the low PIA group with some years of college (10 percent of those in the study) show less of a tendency to return to the program than do individuals with less than 13 years of education. Educational level showed no effect beyond the first 5 years after recovery.

Age.—The tendency to return to the program increases with age at recovery. Individuals in the low PIA group aged 50 or older (14 percent of those in the study) show an increased reentitlement tendency in both time periods—first 5 years after recovery and the period beyond 5 years after recovery.

Diagnosis.—Within the first 5 years, only those with low PIA's in the accidents group (21 percent of those in the study) show less of a tendency to return to the program than persons with PIA's less than $500 in other diagnostic groups. No observed effect due to diagnostic group is noted in the time period beyond 5 years after recovery.

High PIA Group

For those in the high PIA group, the tendency to become reentitled is relatively constant in the first 5 years of the postrecovery period. A drop in the tendency to return to the program occurs at 5 years, after which the tendency to become reentitled to disabled-worker benefits increases sharply. The dotted line in chart 1 shows that, as was the case for the low PIA group, the tendency to return to the DI program was different in the designated time periods. The sharp rise in the reentitlement tendency in the second time period will not affect many individuals because about 70 percent of the individuals with a PIA of $500 or more have already experienced one of the three outcomes by the end of 5 years.

For the high PIA group, no other

covariate was observed to affect the tendency to return to the program. For example, within the high PIA group, no differences could be found in the tendency to return to the program either among the diagnostic groups or between men and women. However, the lack of covariate effects in the high PIA group may be due to the smaller sample size in this group.

The Technical Appendix discusses how the covariates were chosen for the models. Time limitations prevented an exhaustive search of all possible models. Instead, efforts focused on identifying those covariates that appeared to be the most important in influencing the reentitlement process.

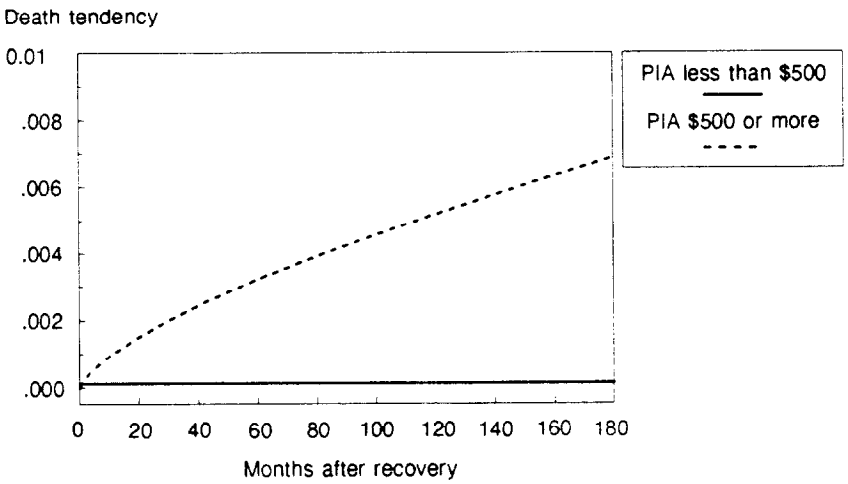
Death Tendency

The tendency that a recovered beneficiary will die as the next outcome after leaving the program was initially modeled using all available covariates. However, only 66 individuals out of 1,713 died as the next event within the timeframe of this study. Because the number of individuals for whom death was the next event in the postrecovery period was very small, fewer covariates were used in the modeling process. One covariate that strongly affected the death tendency was the PIA.

Chart 2 shows the death tendency curves for those in the high PIA group, compared with those in the low PIA group. Overall, the death tendency is higher for those with a PIA of $500 or more.

It is not known exactly why the death tendency is higher for persons in the high PIA group, but it is suspected that the PIA acts as a proxy for the severity of the disabling condition. If the high PIA group consists of individuals with impairments of greater medical severity, the tendency to end the process due to death would be greater for this group. This hypothesis cannot be tested because the data files contain no measure of the severity of the disabling condition. Also, no information exists in the data files to distinguish work recoveries from medical recoveries, so that it is not possible to determine if the individuals in the high PIA group were primarily persons who had work recoveries.

Chart 2.—Death tendencies, by primary insurance amount



Because the tendencies appeared to be very different for the two PIA groups and because the reentitlement tendencies were modeled separately for each group, death tendencies were also modeled separately for the two groups.

Only 19 deaths were observed in the low PIA group of 1,254 individuals. Chart 2 shows the death tendency for the low PIA group; the estimated tendency to die as the next event does not change over time. Because of the small number of deaths for the low PIA group, the data would support only the simplest model. If a greater number of individuals could be studied, one would expect some of the usual demographic variables such as sex and age or a variable such as diagnosis of the disabling condition to be associated with the death tendency.

Only 47 deaths occurred among the 459 individuals in the high PIA group. A model without covariates, but which indicated the death tendency changed over time, was chosen. Chart 2 shows that the tendency for death to be the next event increases over time for individuals with a PIA of $500 or more. Future studies with more individuals would be expected to identify additional covariates for this PIA group.

In this competing risk environment, the tendency that a recovered beneficiary will die as the next event in the postrecovery period is not the same as the usual death rate, which is defined in a different way. Three outcomes or events are of interest here: Reentitlement, death, and retirement. In calculating the usual death rate, the only outcome of interest is death. What has been modeled for this study is the tendency for death to be the next event specified, not the death rate for this population.

Projected Outcomes

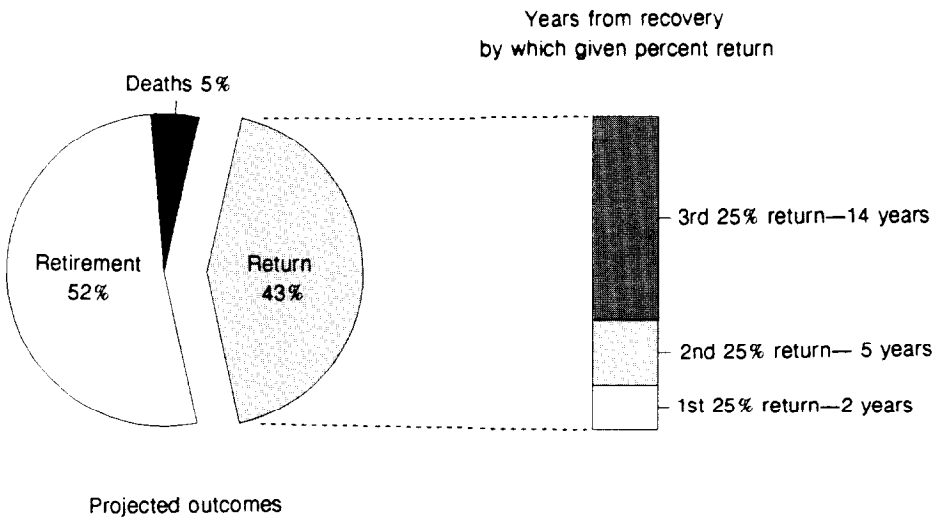
The following sections describe the projected outcomes in the postrecovery period without reference to the covariates. In the sections that follow, findings that include the covariates will be presented and also findings within the low and the high PIA groups.

The percentages presented in this article are not intended as precise estimates of the proportions of individuals who become reentitled to disabled-worker benefits, die, or retire as the next event in the postrecovery process. They are intended instead to provide a broad mosaic of the process that is followed by recovered beneficiaries in the 1972 cohort of entitled disabled workers. The value of this study lies in describing trends in this population and not in detailing exactly how many individuals are expected to have a particular outcome. Thus, the percentages should be viewed as qualitatively describing the postrecovery experience of these individuals. A more detailed description of the limitations of this study is contained in the Summary and Goodness-of-Fit sections in the Technical Appendix.

Reentitlement, Death, or Retirement

Chart 3 shows the percentage of recovered beneficiaries that ultimately return to the DI program, die, or retire as the next event in the postrecovery period. Death as the next event is projected for about 5 percent of recovered beneficiaries. The projections indicate that most beneficiaries either retire (approximately 52 percent) or become reentitled (approximately 43 percent). These percentages are a result of the competing risk situation, in which competing tendencies to return to the program or to die coupled with proximity to retirement age determine ultimately what percentage of individuals become reentitled, die, or retire. Again, retirement is defined as attaining age 62.

Chart 3.—Projected outcomes of postrecovery period and, for those returning to the program, quartiles of reentitlement distribution



Research [1] has indicated that approximately 11 percent of disabled-worker beneficiares entitled in 1972 would recover; this research also projected that approximately 43 percent of the recovered persons in this cohort will become reentitled to DI benefits. Thus, approximately 5 percent (43 percent of 11 percent) of the cohort of disabled-worker beneficiaries entitled in 1972 are projected to recover and then become reentitled.

Time to Next Event

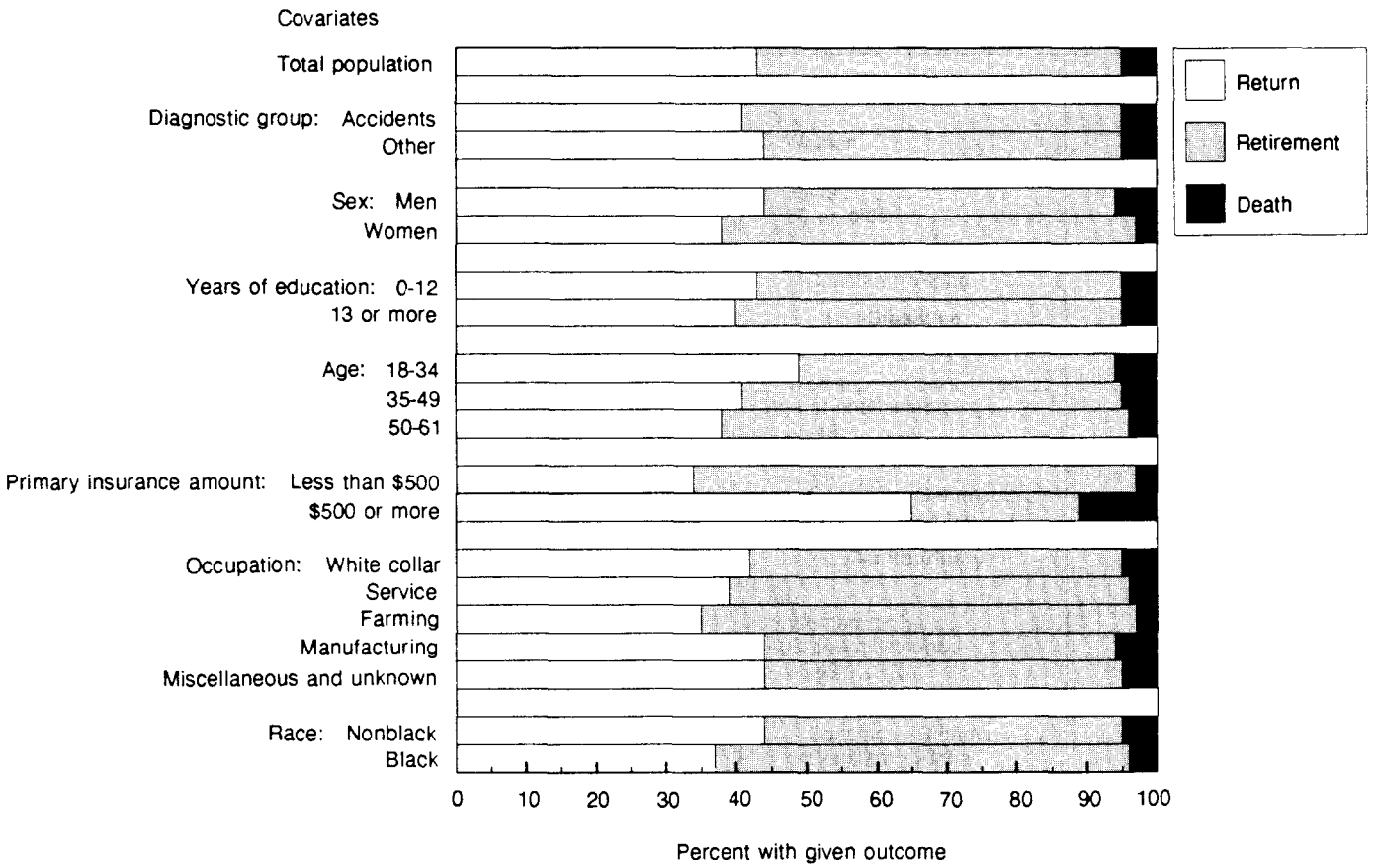
Of the beneficiaries who ultimately return to the DI program during the postrecovery period, it is projected that 25 percent will do so by the end of the second year, 50 percent by the end of the 5th year, and 75 percent by the end of the 14th year after recovery. Therefore, the median length of time to reentitlement is approximately 5 years after recovery. The mean time to reentitlement is approximately 9.3 years—quite different from the median of 5 years because for some individuals the time to reentitlement is very long. These individuals with long reentitlement times cause the mean to be considerably higher than the median.

Outcomes by Covariates

Chart 4 and table 2 show the percentages of recovered beneficiaries who ultimately become reentitled, die, or retire as the next event in the postrecovery period as a function of the individual covariates. The following sections discuss the effects of the other covariates within a PIA group. Certain groups—diagnostic, education, and PIA—have been collapsed based on the results obtained in modeling the tendencies to reentitlement and to death.

Age at recovery.—The percentage of individuals who

Chart 4.—Projected outcomes of postrecovery period, by covariates



ultimately become reentitled to disabled-worker benefits is the highest for the youngest age group—about 49 percent. For the next two older age groups, the percentages of those ultimately reentitled are 41 percent and 38 percent. The percentage who utimately become reentitled is greater for those in the youngest age group. This finding seems contrary to the observed greater tendency for reentitlement among individuals with low PIA's in the older age groups. It may be explained in part by the possibility that the older age group—being closer to age 62—may retire before they become reentitled to benefits under the DI program.

Sex.—The percentage of recovered beneficiaries projected to ultimately become reentitled to disabled-worker benefits is approximately 38 percent for women and 44 percent for men. The reentitlement percentage is somewhat lower for women, despite a greater tendency for women in the low PIA group to become reentitled. As explained above, this can happen because the tendencies toward reentitlement and death along with proximity to retirement age determine the percentage of recovered beneficiaries who ultimately are reentitled. A greater percentage of women than men are expected to retire—about 59 percent, compared with about 50 percent. The different percentages of women and men retiring as the next event is explained, in part, by the different age distributions by sex. Thirty-eight percent of the women are in the oldest age group, compared with 26 percent of the men.

Diagnostic group.—For modeling purposes, the diagnostic groups were more coarsely formed into the two categories listed in table 2: accidents and other. Despite the lesser tendency for some individuals in the accidents group to become reentitled (those also in the low PIA group), the percentage of persons ultimately expected to become reentitled is about the same for those in both groups. Again, this finding is due to the competing risk

Table 2.—Projected outcomes of postrecovery period and, for those who return to the program, quartiles of reentitlement distribution, by selected characteristics

Selected characteristic	Sample size	Percent ending postrecovery period by—			Year reentitlement occurred for the first—		
		Reentitlement	Death	Retirement	25 percent	50 percent [1]	75 percent
Total population	1,713	43	5	52	2	5	14
Primary diagnosis							
Accidents	459	41	5	54	3	9	20
Other	1,254	44	5	51	2	4	11
Sex							
Men	1,347	44	6	50	2	5	14
Women	366	38	3	59	2	4	12
Years of education							
0-12	1,479	43	5	52	2	5	13
13 or more	234	40	5	55	3	8	18
Age at recovery							
18-34	579	49	6	45	5	14	25
35-49	647	41	5	54	2	4	10
50-61	487	38	4	58	1	3	4
Primary insurance amount							
$1-$499	1,254	34	3	63	3	10	20
$500 or more	459	65	11	24	2	3	7
Occupation							
White collar	370	42	5	53	2	4	12
Service	206	39	4	57	2	5	16
Farming	57	35	3	62	2	9	21
Manufacturing	513	44	6	50	2	5	13
Unknown and miscellaneous	567	44	5	51	2	5	13
Race							
Nonblack	1,485	44	5	51	2	5	13
Black	228	37	4	59	2	5	14

[1] Median year.

situation, where the time until retirement and the tendency to die also influence the probability that the next event in the postrecovery period is reentitlement to disabled-worker benefits.

Education.—Although a lesser tendency to return to the DI program was noted for individuals in the low PIA group with 13 years or more of education, little difference was found in the percentages for the education groups.

Primary insurance amount.—The percentage of individuals in each PIA group who eventually become reentitled to disabled-worker benefits is strikingly different. About 34 percent of those in the low PIA group (less than $500) are projected to become reentitled, compared with about 65 percent of those in the high PIA group ($500 or more). Differences were also found in the percentages of persons for whom death was the next event in the postrecovery process: 3 percent of the low PIA group and 11 percent of the high PIA group. Among the individuals in the low PIA group, retirement was the next event for about 63 percent, compared with about 24 percent of the individuals in the high PIA group. Thus, individuals with high PIA's are more likely than those with low PIA's to return to the program or to die as the next event in the postrecovery period. Although the high PIA group consists of older individuals who are closer to retirement ages, the tendencies to return to the program or to die as the next event dominate and the percentage of individuals who retire is lower in the high PIA group.

Occupation and race.—Some differences in the percentages of

recovered beneficiaries who are expected to become reentitled or retire as the next event in the postrecovery period were found among occupational and racial groups. However, when their PIA status is a factor in the analysis, these differences disappear or become muted. This point is discussed in the next section.

Outcomes Within PIA Groups

Because the primary insurance amount was such an important variable in the modeling process, separate tables were created for the two PIA groups. Table 3 and chart 5 show the percentages for individuals in the low PIA group. Table 4 and chart 6 contain the percentages for individuals in the high PIA group.

In the low PIA group, the most striking difference in the percentages of persons who ultimately become reentitled to disabled-worker benefits lies in a comparison of the three age groups. As expected, the two oldest groups—aged 35-49 and aged 50-61—more often end the postrecovery process with retirement than do those aged 18-34. The percentage of recovered beneficiaries who ultimately are reentitled is largest among the youngest age group—about 44 percent. Reentitlement projections for the middle age group and the oldest age group are 29 percent and 27 percent, respectively. The percentages of those who are projected to die as the next event seem to follow an unexpected trend, with the lowest percentage related to the oldest age group. The percentages and the differences among percentages are, however, very small.

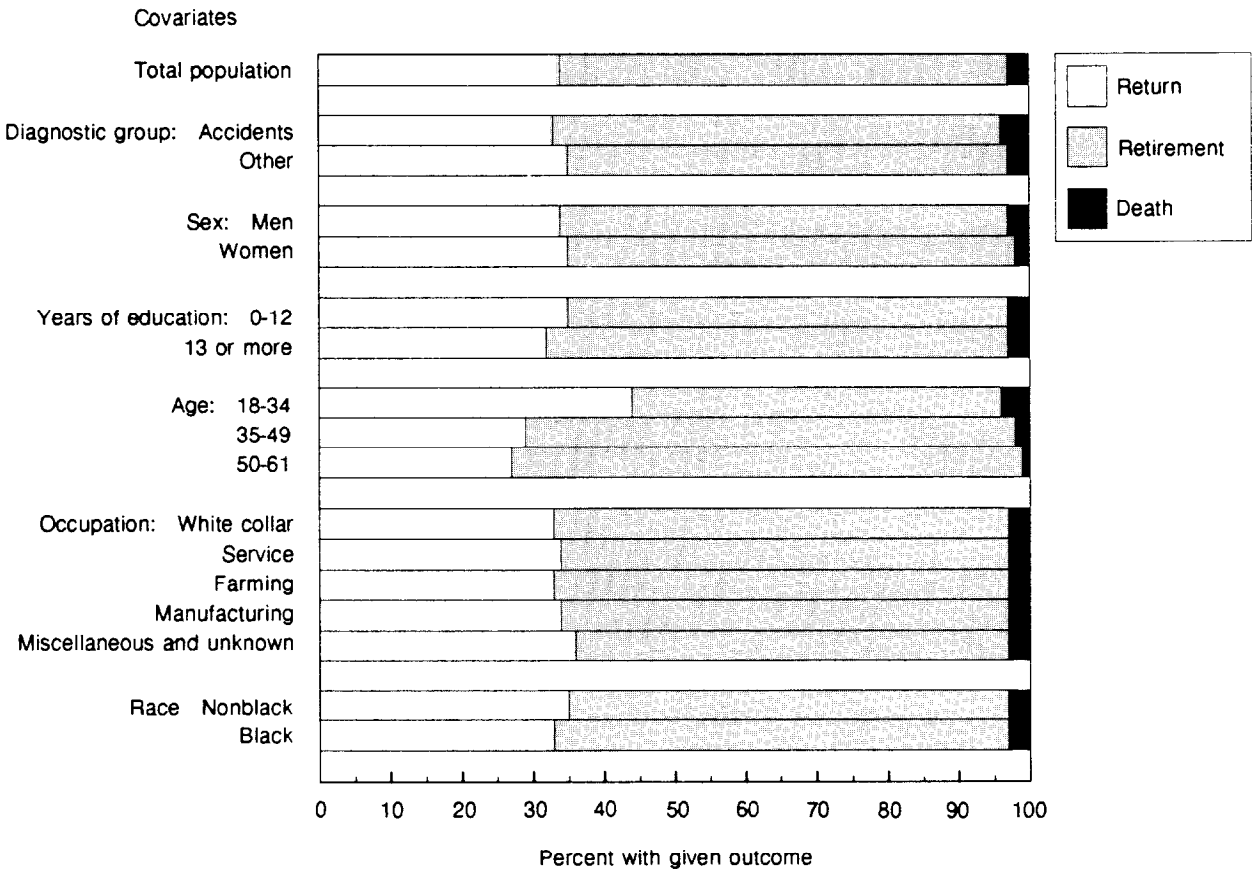
Among the groups of other covariates, no large differences were found in the percentages of individuals ultimately becoming reentitled to disabled-worker benefits. The difference between men and women becomes smaller when only individuals with low PIA's are considered (table 2). The data in table 3 illustrate that the differences in reentitlement percentages that are observable in table 2 among racial and

Table 3.—Projected outcomes of postrecovery period and, for those who return to the program, quartiles of reentitlement distribution, by selected characteristics for recovered beneficiaries with PIA less than $500

Selected characteristic	Sample size	Percent ending postrecovery period by—			Year reentitlements occurred for the first—		
		Reentitlement	Death	Retirement	25 percent	50 percent [1]	75 percent
Total population	1,254	34	3	63	3	10	22
Primary diagnosis							
Accidents	363	33	4	63	7	16	25
Other	891	35	3	62	2	6	19
Sex							
Men	936	34	3	63	3	12	22
Women	318	35	2	63	2	4	15
Years of education							
0-12	1,083	35	3	62	2	9	20
13 or more	171	32	3	65	4	14	24
Age at recovery							
18-34	508	44	4	52	8	19	27
35-49	501	29	2	69	2	5	13
50-61	245	27	1	72	1	3	4
Occupation							
White collar	262	33	3	64	3	8	20
Service	174	34	3	63	2	8	20
Farming	51	33	3	64	3	11	22
Manufacturing	352	34	3	63	3	10	21
Unknown and miscellaneous	415	36	3	61	3	9	20
Race							
Nonblack	1,054	35	3	62	3	10	21
Black	200	33	3	64	2	6	18

[1] Median year.

Chart 5.—Projected outcomes of postrecovery period, by covariates, for recovered beneficiaries with PIA less than $500



occupational groups disappear once the PIA is taken into account.

A look at the data for those within the high PIA group also shows substantial differences among age groups. Among those individuals with high PIA's who are aged 18-34 at recovery, 84 percent are projected to eventually return to the DI program; among those aged 35-49 at recovery, the projection is 83 percent. The percentage drops to 49 percent for those with high PIA's in the oldest age group. The retirement probabilities for these age groups also differ. As was true among the low PIA group, the percent retiring is greatest for those in the oldest age group. However, because of strong reentitlement and death tendencies for individuals with high PIA's, the proportion for whom retirement was the next event is very small in the two youngest age groups. The percentages for whom death is the next event are also reversed from what would be expected. Death as the next event is projected for 15 percent of those in the two youngest age groups, compared with 8 percent in the oldest age group. This trend was also observed in the raw data. It is not clear why this trend occurs.

Within the high PIA group, some differences are seen in the percentage of men and women projected to return to the DI program. A greater percentage of men than women is projected to return to the program or die. Although this covariate did not appear to affect the tendency to return to the DI program within the high PIA group, the percentages of men and women becoming reentitled can differ because they also depend on the proximity to retirement age.

Within the high PIA group, some small differences were observed in the reentitlement, death, and retirement probabilities for the covariates of primary diagnosis, education, and occupation. The difference in percentages by racial groups is negligible for those in the high PIA group (table 4).

Table 4.—Projected outcomes of postrecovery period and, for those who return to the program, quartiles of reentitlement distribution, by selected characteristics for recovered beneficiaries with PIA $500 or more

Characteristic	Sample size	Percent ending postrecovery period by—			Year reentitlement occurred for the first—		
		Reentitlement	Death	Retirement	25 percent	50 percent [1]	75 percent
Diagnostic group							
Accidents	96	68	12	20	2	4	7
Other	363	65	11	24	2	3	7
Sex							
Men	411	66	12	22	2	4	7
Women	48	56	10	34	2	3	6
Years of education							
0-12	396	66	11	23	2	4	7
13 or more	63	62	11	27	2	4	7
Age at recovery							
18-34	71	84	15	1	2	4	8
35-49	146	83	15	2	2	4	8
50-61	242	49	8	43	1	3	4
Occupation							
White collar	108	62	11	28	2	3	6
Service	32	63	11	26	2	3	7
Farming	6	[2]	[2]	[2]	[2]	[2]	[2]
Manufacturing	161	68	12	20	2	4	7
Unknown and miscellaneous	152	66	12	23	2	3	7
Race							
Nonblack	431	65	11	24	2	4	7
Black	28	66	12	22	2	4	7

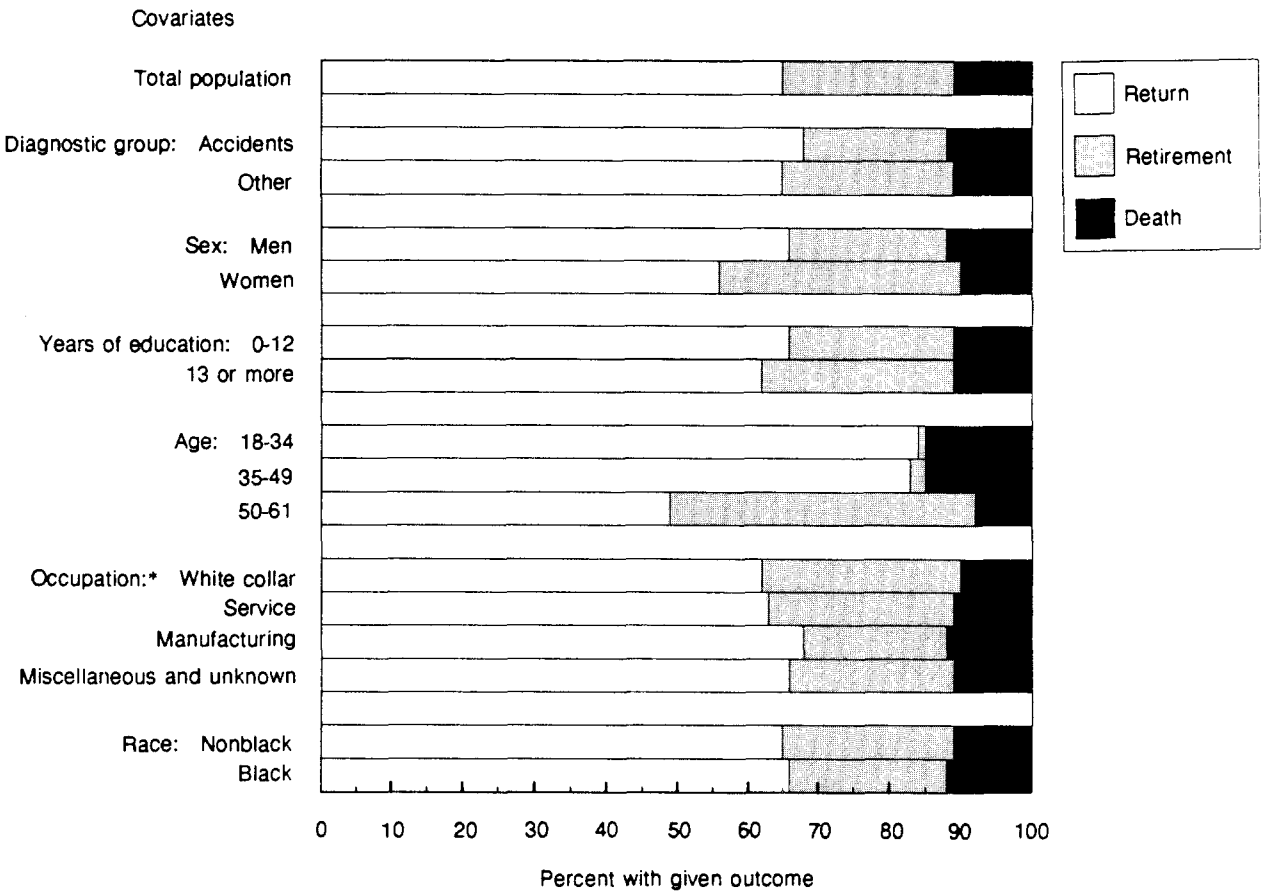
[1] Median year.
[2] Values not shown due to small number of individuals in group.

One of the striking features in a comparison of the data in tables 3 and 4 (for the low and high PIA groups) is the appearance of higher percentages in table 4 in the reentitlement column for the group with high PIA's. The percentage of individuals with low PIA's projected to become reentitled ranges across the three age groups from 44 percent to 27 percent; across the three age groups with high PIA's, the range is from 84 percent to 49 percent. If covariate groups other than age are examined, the percentage of individuals with low PIA's projected to return to the program ranges from 32 percent to 36 percent depending on the covariate group; among persons with high PIA's, the range is from 56 percent to 68 percent, depending on the covariate group. The higher reentitlement percentages for individuals in the high PIA group are a result of the previously discussed greater tendency for those individuals to return to the DI program.

Another striking feature in a comparison of the data in these tables is the higher percentages of deaths recorded for the high PIA groups shown in table 4. In the groups with low PIA's, the percentage of persons projected to have death as the next postrecovery period event ranges from 1 percent to 4 percent, compared with 8 percent to 15 percent for the high PIA groups. These higher death percentages for groups of individuals with high PIA's are a result of their greater death tendency, as discussed above.

Tables 3 and 4 also contain information about how long it takes for persons with various characteristics to become reentitled to benefits under the DI program. The tables show the years in which 25 percent, 50 percent, and 75 percent of individuals with various characteristics have become reentitled. If the oldest group—

Chart 6.—Projected outcomes of postrecovery period for recovered beneficiaries with PIA $500 or more



*Farming not shown due to small sample size.

those aged 50-61—is excluded, 75 percent of persons with low PIA's who return to the DI program do so within 13 years to 27 years, depending on characteristics other than age (table 3). This is in marked contrast to the data in table 4 that show 75 percent of persons with high PIA's who return to the DI program (except in the oldest age group) do so in 6-8 years, depending on the other characteristics.

Thus, individuals with high PIA's are more likely to return to the DI program and to do so in a shorter amount of time. The median time to reentitlement is more fully discussed below.

In table 5, the effects of covariates are shown when age at recovery and PIA are both taken into account. The data show the effect of sex and primary diagnosis by age group; this information is focused on those in the low PIA group and the high PIA group.

Median Year of Reentitlement

Table 2 shows the median number of years to reentitlement for individuals who become reentitled, overall and by various characteristics. The median is the year in which 50 percent of the reentitlements occurred. For the total reentitled group, the median is 5 years.

Those in the accidents group, compared with those in the other diagnostic group, have a longer time to reentitlement—a median of 9 years, compared with a median of 4 years. The comparison for men and women shows their medians to be very close, 5 years and 4 years, respectively. Those with 13 years or more of education have a longer elapsed median time to reentitlement—8 years—than those with less education—5 years. The three age groups are different in the median number of years between

Table 5.—Projected outcomes of postrecovery period and, for those who return to the program, quartiles of reentitlement distribution, by primary insurance amount, sex, and diagnostic group within age groups

Characteristic	Sample size	Percent ending postrecovery period by—			Year reentitlement occurred for the first—		
		Reentitlement	Death	Retirement	25 percent	50 percent [1]	75 percent
	Total						
Total population	1,713	43	5	52	2	5	14
Age 18-34	579	49	6	45	5	14	25
Sex:							
Men	485	49	6	45	5	14	25
Women	94	49	5	46	4	14	25
Diagnostic group:							
Accidents	214	47	6	47	7	17	26
Other	365	50	6	44	4	12	24
Age 35-49	647	41	5	54	2	4	10
Sex:							
Men	514	42	6	52	2	5	10
Women	133	35	3	62	2	4	9
Diagnostic group:							
Accidents	161	35	5	60	3	6	12
Other	486	43	5	52	2	4	9
Age 50-61	487	38	4	57	1	3	4
Sex:							
Men	348	40	5	55	1	3	5
Women	139	32	2	66	1	2	4
Diagnostic group:							
Accidents	84	33	5	62	2	3	5
Other	403	39	4	57	1	3	4
	PIA less than $500						
Total population	1,254	34	3	63	3	10	20
Age 18-34	508	44	4	52	8	19	27
Sex:							
Men	422	44	4	52	9	19	27
Women	86	46	4	50	5	18	26
Diagnostic group:							
Accidents	191	43	4	53	12	21	28
Other	317	45	4	51	6	18	26
Age 35-49	501	29	2	69	2	5	13
Sex:							
Men	378	28	3	70	2	5	13
Women	123	31	2	67	2	4	10
Diagnostic group:							
Accidents	130	24	3	74	3	9	16
Other	371	30	3	67	2	4	11
Age 50-61	245	27	1	72	1	3	4
Sex:							
Men	136	25	1	74	1	3	4
Women	109	30	1	69	1	2	4
Diagnostic group:							
Accidents	42	19	1	80	2	4	7
Other	107	29	1	70	1	2	4

See footnote at end of table.

Table 5.—Projected outcomes of postrecovery period and, for those who return to the program, quartiles of reentitlement distribution, by primary insurance amount, sex, and diagnostic group within age groups—**Continued**

Characteristic	Sample size	Percent ending postrecovery period by—			Year reentitlement occurred for the first—		
		Reentitlement	Death	Retirement	25 percent	50 percent [1]	75 percent
	PIA $500 or more						
Total population	459	65	12	23	2	4	7
Age 18-34	71	84	15	1	2	4	8
Sex:							
Men	63	84	15	1	2	4	8
Women	8	84	15	1	2	4	8
Diagnostic group:							
Accidents	23	84	15	1	2	4	8
Other	48	84	15	1	2	4	8
Age 35-49	146	84	15	1	2	4	8
Sex:							
Men	136	84	15	1	2	4	8
Women	10	84	15	1	2	4	8
Diagnostic group:							
Accidents	31	84	15	1	2	4	8
Other	115	84	15	1	2	4	8
Age 50-61	242	49	8	43	1	3	4
Sex:							
Men	212	50	8	42	1	3	4
Women	30	40	6	54	1	2	4
Diagnostic group:							
Accidents	42	48	8	44	1	3	4
Other	200	49	8	43	1	3	4

[1] Median year.

benefit termination and reentitlement. The median for the youngest group is 14 years, compared with 4 years for individuals in the middle age group and 3 years for individuals in the oldest age group. This finding is not surprising because individuals in the oldest group are closer to retirement and have a shorter time interval in which to become reentitled to disabled-worker benefits.

Considerable differences also exist in average time to reentitlement for the two PIA groups. For those with low PIA's, the median is 10 years; for the high group, the median is only 3 years.

Low and High PIA Groups

Table 3 shows the median number of years to reentitlement by covariates for those with low PIA's. The median differs across the three age groups. Those in the group aged 18-34 have a median time to reentitlement of 19 years, compared with 5 years for those aged 35-49 and 3 years for those aged 50-61. Again, the finding is not surprising because older persons are closer to retirement and have less time in which to become reentitled under the DI program.

For those with low PIA's in the accidents group, the median reentitlement time is 16 years, compared with 6 years for those in the other diagnostic group. This difference is due, in part, to different age distributions because those with low PIA's in the accidents group are younger than the individuals with low PIA's in the other diagnostic group.

Men have a longer median length of time to reentitlement than do women, 12 years and 4 years, respectively. This is due, in part, to the different age distributions for men and women with low PIA's. The men in the low PIA group are younger than women in that PIA group.

Education appears to influence the elapsed time to reentitlement. Those with 13 years or more of education have a longer median

time to reentitlement. Again, this difference is due, in part, to the younger ages of those individuals with the most education.

In table 4, the median number of years to reentitlement is shown by covariates for the high PIA group. The median is either 3 years or 4 years, with no substantial differences found among the covariate groups, even for the covariate age.

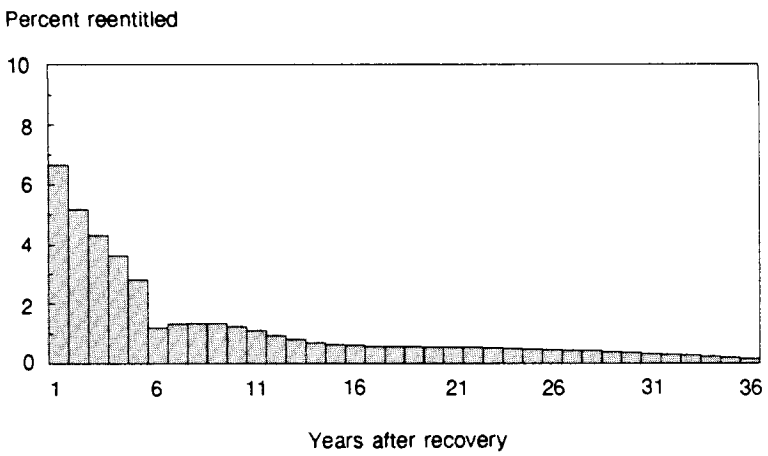
The median number of years to reentitlement varies more across covariates for those in the low PIA group than for those in the high PIA group (tables 3 and 4). The greater variability in median years to reentitlement for individuals with low PIA's may occur because individuals with high PIA's return to the program relatively quickly, and proximity to retirement age is less important in calculating the median time to reentitlement. It may also be due to models that incorporated additional covariates for the low PIA group but not for the high PIA group.

In summary, the median ranges from 3 years to 19 years for the low PIA group, depending on the characteristic or covariate. For the high PIA group, the median ranges from 3 years to 4 years. For these subgroups based on other characteristics, the median year for the high PIA group is equal to or less than the corresponding median year for the low PIA group.

Projected Time to Reentitlement

Chart 7 shows the projected number of years between recovery and reentitlement. It graphically illustrates the effects of the reentitlement and death tendencies. The percentage of reentitlements is highest during the first 5 years of the postrecovery period. Although

Chart 7.—Distribution of length of time to reentitlement



Note: Less than 0.5 percent are projected to return after 36 years.

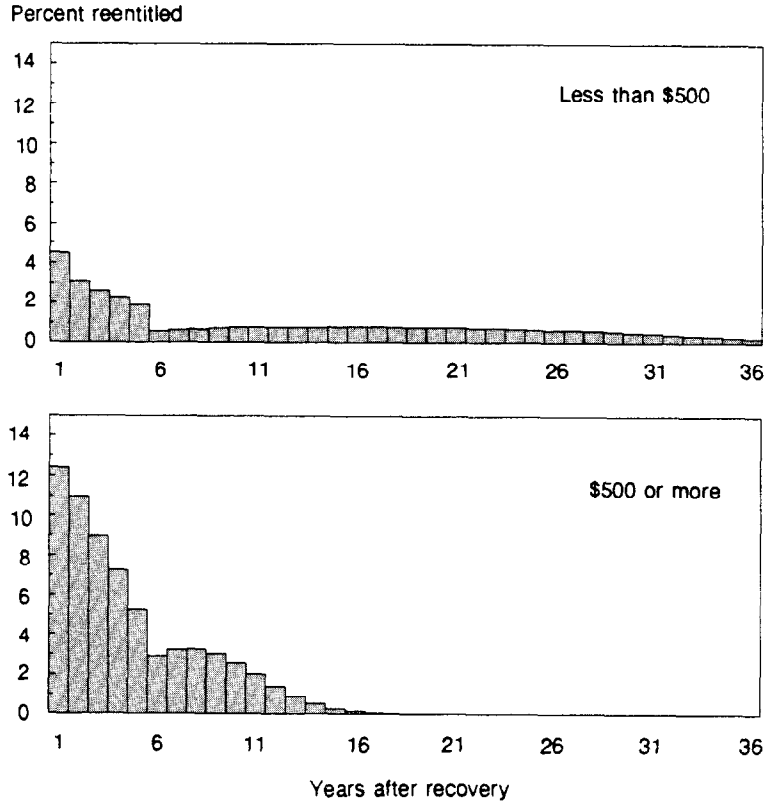
43 percent of all those whose benefits were terminated are ultimately expected to become reentitled, 23 percent are expected to become reentitled in the first 5 years of the postrecovery period. The percentage of recovered individuals returning to the program declines during the first 5 years and drops markedly after the fifth year. Although a slight trend for the percentage to increase and then decrease in the period beyond 5 years after recovery is seen, the more striking trend in this period is a gradual decline in the percentage of persons who return to the DI program.

When the distribution of reentitlement times is plotted separately for those in each PIA group, quite different pictures emerge (chart 8). The percentage of recovered beneficiaries who are reentitled is lower in the low PIA group, compared with the the high PIA group. In addition, those in the low PIA group have longer times to reentitlement than those in the high PIA group.

In the low PIA group, the percentages of those who are projected to ultimately become reentitled in each of the first 6 years are 4.5 percent, 3.1 percent, 2.6 percent, 2.3 percent, 1.9 percent, and 0.6 percent, respectively. Within the first 5 years, 14 percent of a total 34 percent of individuals in the low PIA group are expected to become reentitled.

In the high PIA group, the percentages of those who are projected to ultimately become reentitled in each of the first 6 years are 12.4 percent, 11.0 percent, 9.0 percent, 7.3 percent, 5.3 percent, and 2.9 percent, respectively. Within the first 5 years, 45 percent of a total of 65 percent for individuals with high PIA's are expected to become reentitled to disabled-worker benefits.

Chart 8.—Distribution of length of time to reentitlement, by primary insurance amount



Note: Less than 0.5 percent of those with a PIA less than $500 are projected to return after 36 years.

Study Limitations

It is possible that deaths may be underreported because data regarding deaths were obtained from the Master Beneficiary Record (MBR) through claims filed by survivors or funeral homes. This underreporting is not believed to be substantial, and no alternative data source was available for obtaining information on deaths.

Although standard errors and confidence limits would have been highly desirable in describing the percentages, their calculation imposed a significant computational burden. Complex mathematical formulas were used to obtain the percentages of those ultimately becoming reentitled, dying, or retiring as the next postrecovery event. The standard errors were not easy to obtain using these formulas. Thus, these percentages should be viewed in a descriptive light.

About one-half of the 1,713 persons studied were actually observed to either become reentitled, die, or retire as the next event in the postrecovery period. Information from these individuals was used to identify trends and to make projections about what would happen if all individuals were observed until one of these three outcomes occurred. The basis for these projections is observations during the timeframe of this study. If, over the later time periods that were not observed, tendencies toward reentitlement or death for these individuals were to change markedly, the projections might be quite different. However, because about half of these individuals were observed to have one of the three outcomes and because the observation period was at least 65 months for those having no outcome, a considerable amount of information is available about the postrecovery process. The Technical Appendix contains more information regarding model projections for certain subgroups in which the next event was observed for almost all individuals in that subgroup. (See the Goodness-of-Fit section on page 00.)

Summary

This study followed a 1972 cohort of newly entitled beneficiaries from January 1, 1981, when they left the Disability Insurance program because of a recovery, to June 1986. This recovery group represents about 11 percent of the cohort of disabled-worker beneficiaries entitled in 1972. Three outcomes or next events were of specific interest: Return to the DI program, death, and attaining age 62 (considered retirement for the purposes of this study). The tendency toward reentitlement and the tendency toward death were modeled and then combined with retirement age to project the percentages of recovered beneficiaries who end the postrecovery period by reentitlement, death, or retirement.

About 43 percent of these recovered beneficiaries are expected to become reentitled some time after leaving the program, and 52 percent are expected to reach retirement age before dying or becoming reentitled. Of the 43

percent projected to return to the program, 23 percent are expected to become reentitled within the first 5 years of recovery. The tendency to return to the DI program drops sharply at the fifth year of the postrecovery period. There may be program-based reasons for this pattern. The Social Security Amendments of 1960 and the Social Security Disability Amendments of 1980 may provide incentives to return to the DI program within 5 years.

When covariates were examined, the covariate PIA had a strong effect on the reentitlement tendency. For those in the high PIA group ($500 or more), it is projected that 65 percent will return to the DI program. This projection is considerably higher than the 34 percent projection for those in the low PIA group (less than $500).

Projected median time to reentitlement is quite different for the two PIA groups. The median time to reentitlement is 10 years for the low PIA group and only 3 years for the high PIA group.

The PIA was also important in modeling the death tendency as the next event in the postrecovery period. For those in the low PIA group, death is the next event projected for 3 percent of the individuals; in the high PIA group, the projected proportion is 11 percent. It is suspected that the PIA may be acting as a proxy for the severity of the disabling condition, but this hypothesis cannot be tested with the available data.

These descriptions of the reentitlement and death tendencies and the projected percentages provide a global picture of the DI program reentitlement process. Further research will continue by comparing this pre-1980's cohort with a later cohort and studying the causal mechanisms underlying the recovery and reentitlement processes.

References

[1] Hennessey, John C. and Dykacz, Janice M., "Projected Outcomes and Length of Time in the Disability Insurance Program," **Social Security Bulletin**, September 1989, pages 2-41.

[2] World Health Organization, **Manual of the International Classification of Diseases, Injuries, and Causes of Death**, Eighth Revision, Geneva, 1967.

[3] Department of Labor, **Dictionary of Occupational Titles**, Washington, DC, 1965.

Technical Appendix

Data File

A long-range projection that 11 percent of the 18,816 disabled-worker beneficiaries in the sample are expected to ultimately recover is made in the first article of this issue by Hennessey and Dykacz [1]. However, a smaller percentage were actually observed to recover during the timeframe of this study. Only those individuals who were observed to recover by January 1, 1981, were chosen for this study because substantial administrative changes in the disability review procedure and court intervention regarding program terminations began about this time. Of the 18,816 individuals who were entitled to disabled-worker benefits in 1972, 1,731 recovered by January 1, 1981. The analysis excludes 18 of these recovered individuals because they were aged 62 or older at the time of recovery and eligible for early retired-worker benefits. Information is not available in the data files that distinguishes between retired-worker beneficiaries and disabled-worker beneficiaries. Thus, the individuals in this study are the 1,713 recovered beneficiaries who were younger than age 62 at recovery and who were included in the 5-percent sample of disabled-worker beneficiaries entitled in 1972.

Distribution of Covariates by PIA Groups

In the reentitlement analysis, the primary insurance amount (PIA) is an important covariate. For this reason, covariate distributions are presented for the two PIA groups used in the analysis—low (PIA value of less than $500) and high (PIA value of $500 or more). The characteristics of those in each group are different. Table 1 in this article shows the demographic characteristics of recovered beneficiaries in the two PIA groups.

Model Estimation

The formulas used to calculate the probabilities of reentitlement, death, or retirement, are similar to those contained in the first article of this issue [1]. For this study of the postrecovery experience, $h_r(t,x)$ is the hazard function for reentitlement. An individual is assumed to retire at age 62.

Initial attempts at modeling the reentitlement hazard function using a single Weibull model indicated some lack of fit with the data. There are program-based reasons for considering a two-part Weibull model, using 60 months or 5 years as the point at which the two parts are joined. The Social Security Amendments of 1960 eliminated the waiting period for cash benefits if the recovered beneficiary is disabled within 5 years after last benefit receipt. The Social Security Amendments of 1980 waived a 2-year Medicare waiting period if the recovered beneficiary is disabled again within 60 months. Thus, possible incentives exist to return to the program within 60 months or 5 years. Likelihood-ratio tests confirmed that the two-part Weibull model provided a better fit to the data than the one-part Weibull model.

Covariate Effects

Covariates such as primary diagnosis, education, PIA, occupation, sex, age, and race were introduced into the model. Equation (1) describes the hazard function when covariates are introduced into the Weibull model.

$$h_r(t,x_1, \ldots, x_n) = \frac{e^{\gamma t} e^{\gamma - 1}}{[e^{\beta_0 + \beta_1 x_1 + \ldots + \beta_n x_n}]^{e^{\gamma}}} \quad (1)$$

The effect of the covariate on the tendency to become reentitled can be assessed by examining the coefficients $\beta_1, \beta_2, \ldots, \beta_n$ in this equation.

An assumption in this model is that the same shape parameter γ can be used for all covariate groups. Initial attempts at this straightforward introduction of covariates into the model indicated a lack of fit for some subgroups.

The covariate PIA was introduced into the model allowing for different values of γ for a low PIA group and a high PIA group. The low PIA group consists of recovered beneficiaries with a PIA value of less than $500; the high group consists of recovered beneficiaries whose PIA is $500 or more. Values of γ for the two PIA groups and for the two parts of each model are quite different. In general, the reentitlement tendency is higher for the high PIA group than for any low PIA subgroup. Because different shapes for the hazard functions were needed for the two PIA groups, the data were analyzed separately for each group.

Low PIA.—Table I presents the coefficient estimates of the reentitlement hazard function for the low PIA group for both the full model and the reduced model. The full model includes the covariates of primary diagnosis, education, occupation, age, sex, and race for both parts (first 5 years of the postrecovery period and the period beyond 5 years after recovery). Because only

15 recovered beneficiaries had been diagnosed with diseases of the respiratory system, that diagnostic group was collapsed with the other diagnostic group.

The reduced model was obtained by omitting any covariates that were not statistically significant in the full model, using two-sided t-tests at the 0.05 significance level. No attempt was made to do a detailed analysis of all possible models containing various combinations of the covariates because of time constraints and the computational burden demanded by such an analysis.

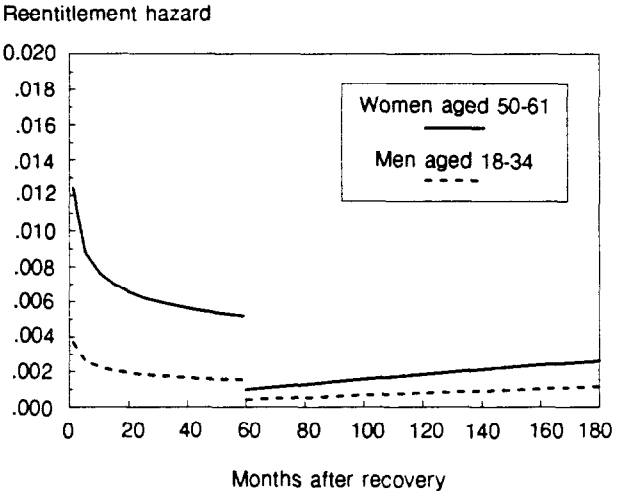
For the first part of the model (the first 5 years out of the program) and for those having a low PIA, several covariates are significant, using two-sided t-tests at the 0.05 level. In the reduced model, the coefficient estimate for women, compared with men, is -0.36. The negative sign in this mathematical formulation indicates that these women have a greater tendency to return to the DI program in the first 5 years than do men. This difference occurs because the reference group in this model is men and because the coefficient describing the effect of sex on the reentitlement tendency is in the denominator of equation (1). The coefficient estimate for those having some years of college, compared with other educational levels, is positive, indicating that recovered beneficiaries in the low PIA group and with some college have less of a tendency to return to the program in the first 5 years after recovery. The trend with age is that the reentitlement tendency increases with age at recovery. Among diagnostic groups, those in the accidents group show less of a tendency to return to the program in the first 5 years than those with other diagnoses.

In the second part of the model, age is the only significant covariate for persons in the low PIA group. Recovered beneficiaries who were in the group aged 50-61 at recovery had the greatest tendency to return to the program.

Chart I shows the hazard functions based on the reduced models for two subgroups with low PIA's: Men in the youngest age group with less than 13 years of education and whose primary diagnosis is not accidents and women in the oldest age group with less than 13 years of education and not in the accidents group. Because the same shape parameter γ in equation (1) is used for both subgroups, the shapes of the hazard functions are similar. Differences are due to differences among the estimates of the parameters $\beta_1, \beta_2, \ldots, \beta_n$ in the two parts of the models.

The hazard function, which measures the reentitlement tendency, declines in the first 5 years after recovery. There is a drop in the tendency at 5 years. In the period beyond 5 years after recovery, the reentitlement tendency begins to increase gradually.

Chart I.—Hazard functions for persons with PIA less than $500, education less than 13 years, and not in the accidents group



High PIA.—No covariates were statistically significant for the high PIA group for either part of the full model (table II). The reentitlement hazard function for the high PIA group has a different shape from either of the two hazards shown for the low PIA group because the value for the shape parameter γ is different. (See chart 1 in the article.) For the high PIA group, the reentitlement tendency is relatively constant for the first 5 years after recovery. The hazard function drops at 5 years. For the second period, beyond 5 years after recovery, the hazard function increases sharply. However, this part of the hazard function will not affect many individuals because about 70 percent of the persons in the high PIA group have already experienced one of the three outcomes by the end of 5 years.

Except for the beginning months in the postrecovery period, the hazard function for the high PIA subgroup is larger than the hazard function for the low PIA subgroup. This low PIA subgroup has the largest hazard function of all the low PIA subgroups.

In summary, some additional covariate effects were observed for those individuals in the low PIA group, but not for individuals in the high PIA group. The dominant effect is established by the covariate PIA.

Death Hazard Function

The coefficients for the death hazard function are shown in table III. The death hazard function describes the tendency for a recovered beneficiary to die at a

Table I.—Coefficient estimates of reentitlement hazard functions, for PIA less than $500

Variable [1]	Full model				Reduced model [2]	
	Part I: Time less than 5 years		Part II: Time greater than or equal to 5 years		Part I	Part II
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	Coefficient
Constant	6.27	[3] 10.87	6.31	[3] 11.73	6.80	6.35
Sex						
Women	−.48	[3] −2.04	−.23	−1.14	−.36	---
Occupation						
Service	−.04	−.10	−.02	−.07	---	---
Farming	.20	.23	−.29	−.82	---	---
Manufacturing	−.22	−.62	−.01	−.06	---	---
Unknown and miscellaneous	−.26	−.72	.13	.51	---	---
Years of education						
9-11	.47	1.53	.19	.90	---	---
12	.49	1.57	.36	1.52	---	---
13 or more	1.14	[3] 2.31	1.30	1.90	.77	---
Unknown	.33	.74	−.58	-1.86	---	---
Age at entitlement						
35-49	−.63	[3] -2.29	−.42	-1.92	−.67	---
50 or older	-1.10	[3] -3.40	−.56	[3] -2.01	-1.17	−.43
Race						
Black	.08	.31	.26	1.03	---	---
Diagnostic group						
Infective	.55	1.15	−.40	-1.00	---	---
Neoplasms	1.32	1.39	−.01	−.01	---	---
Mental disorders	−.18	−.49	−.22	−.61	---	---
Nervous system	.42	.67	−.20	−.48	---	---
Digestive	.30	.36	.12	.14	---	---
Musculoskeletal	.64	1.78	−.21	−.63	---	---
Congenital anomalies	.66	.80	.31	.45	---	---
Accidents	1.26	[3] 3.15	.31	.90	.99	---
Other	.31	.64	1.17	1.76	---	---
Constant: Gamma	−.23	[3] -3.22	.69	[3] 2.50	−.24	.62

[1] Reference groups: Sex, men; occupation, white collar; education, 0-8 years; age, 18-34; race, nonblack; and diagnostic group, circulatory system.

[2] For the reduced model, a covariate group with no coefficient is combined with the reference group.

[3] Significant at the 0.05 level.

Table II.—Coefficient estimates of reentitlement hazard functions, for primary insurance amount $500 or more

Variable [1]	Full model				Reduced model [2]	
	Part I: Time less than 5 years		Part II: Time greater than or equal to 5 years		Part I	Part II
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	Coefficient
Constant	3.83	[3] 4.91	4.72	[3] 9.87	4.38	4.76
Sex						
Women	.44	.45	.29	.35	---	---
Occupation						
Service	.12	.12	−.31	−.36	---	---
Farming	.12	.12	−.81	−.84	---	---
Manufacturing	.10	.11	−.13	−.26	---	---
Unknown and miscellaneous	.23	.23	−.11	−.22	---	---
Years of education						
9-11	.02	.02	.22	.3	---	---
12	.31	.32	.21	.29	---	---
13 or more	.49	.50	.10	.13	---	---
Unknown	.57	.57	.03	.04	---	---
Age at entitlement						
35-49	.32	.33	−.10	−.26	---	---
50 or older	.48	.51	.26	.44	---	---
Race						
Black	−.46	−.47	.27	.27	---	---
Diagnostic group						
Infective	−.28	−.28	−.33	−.34	---	---
Neoplasms	.04	.04	.03	.04	---	---
Mental disorders	−.32	−.33	−.10	−.11	---	---
Nervous system	−.07	−.08	−.17	−.19	---	---
Digestive	−.19	−.19	−.10	−.10	---	---
Musculoskeletal	−.14	−.14	−.14	−.24	---	---
Congenital anomalies	−.86	−.86	1.11	1.11	---	---
Accidents	.07	.07	.06	.09	---	---
Other	−.51	−.51	.17	.19	---	---
Constant: Gamma	.06	.10	1.28	1.58	.05	1.11

[1] Reference groups: Sex, men; occupation, white collar; education, 0-8 years; age, 18-34; race, nonblack; and diagnostic group, circulatory system.

[2] For the reduced model, a covariate group with no coefficient is combined with the reference group.

[3] Significant at the 0.05 level.

particular point in time during the postrecovery period. The larger the value of the hazard function, the greater the tendency or risk. As with the analysis of the reentitlement hazard function, a Weibull model was chosen for the death hazard function because of its flexibility. However, unlike the analysis for the reentitlement hazard function, a one-part model was used because the death tendency was not expected to be affected by administrative rules. Packaged software was used with the formulation for the death hazard function given by

$$h_d(t,x_1, \ldots, x_n) = \frac{\gamma\, t^{\gamma-1}}{[\alpha\, e^{\beta_1 x_1} + \ldots + \beta_n x_n]^{\gamma}} \cdot \quad (2)$$

Initial modeling efforts of the death hazard function indicated that the variable PIA was statistically significant, although some of the usual demographic variables such as age and sex were not significant when the PIA was incorporated into the model. Because the reentitlement hazard function had been estimated separately for the two PIA groups, the death hazard function was also estimated separately for each group. These separate analyses showed that different models should be used for the two PIA groups.

Only 66 deaths were reported among the 1,713 individuals in the sample. When the two PIA groups were considered separately, the number of deaths in the low PIA group was extremely small.

In the low PIA group, only 19 deaths occurred among 1,254 individuals in the sample. A Weibull model as shown in equation (2) was initially used with and without additional covariates. In all cases, the estimate of the scale parameter α, in equation (2) was inappropriate because the confidence interval for this parameter included negative values. This parameter must have a positive value. In addition, the shape parameter γ, was close to 1. Therefore, a simpler model, the exponential model, was used. The exponential model is a special case of the Weibull model, such that the shape parameter γ in equation (2) is fixed at 1. For an exponential model, the hazard function is constant. When no other covariates were used, the estimate for the scale parameter α was appropriate. When additional covariates were introduced, the estimate for the scale parameter α again included negative values. One interpretation is that, because so few deaths occurred, only the simplest exponential model is appropriate for this low PIA group.

Table III.—Coefficient estimates of death function

Variable	Coefficient	T-statistic
PIA less than $500		
Constant: Alpha	7394.53	[1] 4.36
Constant: Gamma[2]	1.00	- - -
PIA $500 or more		
Constant: Alpha	216.41	[1] 9.29
Constant: Gamma	1.69	[1] 7.13

[1] Significant at the 0.05 level.
[2] Coefficient was set at 1.

In the high PIA group, 47 deaths occurred among 459 individuals in the sample. A Weibull model was used with and without additional covariates. There was some indication that the death tendency was lower for individuals in the combined accidents and musculoskeletal group than for individuals in all other diagnostic groups. However, because the Kaplan-Meier survival curves for these two diagnostic groups did not appear to be very different, this covariate was not included in the model. For both groups it is believed that, with a larger data set, it would be appropriate to include some additional covariates such as primary diagnosis, sex, or age in the model.

Goodness-of-Fit

The starting point in the modeling process was to describe the reentitlement tendency and the death tendency. Statistical tests were used to select the variables affecting these tendencies and to compare models. Initial graphic comparisons made between the model and the raw data indicated that the models were capturing the trends in the data.

However, this data set offers a unique opportunity to compare model projections with the raw data. In the three age subgroups within the high PIA group, most individuals have been observed either to return to the DI program, die, or retire as the next event in the postrecovery process.

There are few censored cases—that is, individuals who have not experienced one of these three outcomes by June 1986, because of the strong reentitlement and death tendencies for the high PIA group. For the

first two age subgroups, the model projections are good. For the last subgroup discussed, however, the model projection is not accurate.

In the first age subgroup, consisting of the 71 individuals in the high PIA group who were aged 18-34 at recovery, there were seven censored cases for which the next event was unknown. By June 1986, 57 of these 71 individuals had returned to the DI program. If none of the seven censored cases reflected reentitlements, the percentage of recovered beneficiaries ultimately returning to the program would be 80 percent (57 out of 71). If all seven of the censored cases reflected reentitlements, the percentage of reentitlements would be 90 percent (64 out of 71). Thus, the raw data indicate that 80-90 percent of these individuals will return to the program. The model projects that 84 percent of the individuals with high PIA's in the youngest age group will ultimately become reentitled, so that the projection works well for this subgroup.

For the second age subgroup of individuals with high PIA's aged 35-49 at recovery (146 persons), there are seven censored cases. The number of individuals observed to return to the program by June 1989, is 115. If none of the seven censored cases reflected a reentitlement, the percentage of recovered beneficiaries ultimately returning to the program would be 79 percent (115 out of 146). If all seven censored cases reflected reentitlements, the percentage of reentitlements would be 84 percent (122 out of 146). The model predicts that 83 percent of this subgroup will return to the program, within the range of 79-84 percent determined from the raw data.

In the last age subgroup, consisting of the 242 individuals with high PIA's and aged 50-61 at the recovery, 241 individuals actually attained one of the three outcomes in the timeframe of this study. This phenomenon is due to the relatively high reentitlement rate for individuals in the high PIA group and to the close proximity to retirement age for those individuals in the oldest age group. Whether the individual who has not yet attained one of the three outcomes is excluded or included, the raw data indicate that 41 percent of this subgroup have returned to the program. However, the model projection of 49 percent overestimates the percentage who ultimately return to the program. For this subgroup, the percentage of deaths as the next event in the postrecovery period is overestimated by 1 percent and the percentage of retirements as the next event is underestimated by 9 percent.

Thus, for two of the subgroups discussed above, the model works well. However, for the last subgroup the reentitlement percentage is overestimated by 8 percent. Thus, for certain subgroups the percentage of individuals expected to attain one of the three outcomes may not be precise.

Different models were not extensively tested to eliminate discrepancies between the model and the data; instead a relatively simple model was sought to describe basic trends in the data. Because of some lack of fit between the models and the raw data, it is advisable to use the projections as sign posts pointing to general trends in the population of recovered beneficiaries from the 1972 cohort rather than as precise estimates of the percentage of these individuals who ultimately will become reentitled to disabled-worker benefits die, or retire as the next event in the postrecovery process.