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Methodology in Industrial Health Studies: Social Security Disability Data and the Medical Care System

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This paper is directed at the exploration and development of the Social Security data, in the ascertainment and evaluation of industrial health effects.

The focus of the study is on disability data, as a national uniform means to identify illnesses and disease that occurred prior to death, that were not recorded on the death certificates. A cohort of employees of an industrial company was processed through the Social Security System to simultaneously identify the disability and death claims that were filed.

The total number of white males that filed disability claims was 1,333 and for white females 278. The total number of claims filed for the white males was 1,734 and for white females 382. Comparisons were made of all causes of disability with all causes of death for white males and white females. A remarkably high percentage of causes of disability were not recorded or available by death certificate for ICD categories of diseases and specific cancer sites.

The study also demonstrated that disability data contribute significantly to the confirmation of the diagnosis for the cancer sites. The development of the methodology linking Social Security data on disability, medical care, and mortality with industrial medical and environmental exposure data in epidemiological studies is discussed.

Key words: cohort studies, mortality, linkage methods, death certificates, social security disability

INTRODUCTION

The underlying objective of this research project was directed at the evaluation and use of disability data of the Social Security System as a basic national historical resource in the conduct of epidemiological studies of industrial populations exposed to various environmental agents.

In the development of epidemiological cohort studies to determine the long-term delayed health effects of the microchemical environment, Mancuso initiated and developed the effective utilization of the records of the Social Security System in the ascertainment of occupational risks in epidemiological mortality studies of industrial populations [Mancuso and Coulter, 1959, 1963; Mancuso and El-Attar, 1967; Man-

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cuso et al., 1968]. A basic problem that prevailed in the conduct of mortality pattern studies has been the question of how well the death certificate reflects the biological effects which occurred in prior years for workers exposed to specific toxic and carcinogenic agents.

Social Security disability data and disability patterns as biological indicators have been recognized as potential major contributors to industrial epidemiological studies.

The initial potential use of the Social Security disability data was demonstrated by Kendrick and Fuentes [1966], providing comprehensive information on the nature of seriously disabling conditions experienced by the U.S. work force, by type of industry and occupation.

Popick [1971a,b] provided the initial description of the characteristics of the Social Security disability benefit program for the utilization of the data.

The 1978 Proceedings on Policy Analysis [U.S. DHHS, 1978] provided the most comprehensive description of all the Social Security research files, which include reference to the eight public use data files for disability studies.

A significant governmental development in the use of the disability data was the establishment of a joint collaborative arrangement of the Social Security Administration (SSA) with the National Institute for Occupational Health and Safety (NIOSH) for a system of continuous national analysis directed at the surveillance of disability conditions by type of industry and occupation classifications as designated in the claim process data, expressed in age-adjusted proportional morbidity ratios, as demonstrated in a series of reports [U.S. DHHS/NIOSH, 1985, 1986a, b].

In contrast, the present study on disability is confined to a well-defined cohort of industrial workers who had filed death and disability claims from the beginning of the disability system and had been followed over succeeding years to their termination by death.

This investigation was directed at several fundamental questions relative to the further development of methodology in the study of industrial populations. These questions have been expressed in many ways. They overlap and are interrelated.

They are stated to provide an overview of some of the basic issues. Many other questions can be posed.

1. Does the disability claim indicate a range of diseases not reflected on the death certificate? If so, what is the extent and magnitude of diseases sustained in prior years that are not recorded on the death certificate? What kinds of diseases or disabilities are more commonly not shown on the death certificate? Does an individual who has been granted disability for certain diseases die of the same disability causes? Can disability claims indicate precursors to specific causes of death?
2. Does the disability claim information contribute to the validation of diagnoses of causes of death as recorded in the death certificate? If so, how does the disability information add to confirmation for the respective causes of death? Can disability claim data overcome problems of follow-up of informants and hospital records in prior decades?
3. What is the interval of time prior to death in which the disabling disease antedated the cause of death? Is there a difference in the interval time for different diseases and groups of disease disabilities between alleged onset of disability and date of

death? What clues do they provide to estimates of medical costs and planning for medical care?

4. How can disability disease data complement mortality data in epidemiological studies of industrial populations to detect a change in the pattern of illnesses sustained by an industrial population due to an environmental factor?

MATERIALS AND METHODS

The cohort (1943–1972) of employees of an industrial nuclear facility at one location was initially processed simultaneously for mortality and disability data. Subsequently, there was a reprocessing of the cohort for mortality, an update which did not include disability. The last date for a disability claim was 1975, and the last date for a death in the cohort was 1979. Consequently, the disability claims which occurred during 1975–1979 are not in the present report and the findings per se constitute an understatement of the number of claims of disability for the cohort that were made for the same period. Since the cohort study began in 1943 and the disability cash benefits became available in 1957, there was also loss of disability information for those years.

Further, the present study directed at all employees does not include consideration of the relative differences for the filing of claims for disability, by level of income and risk, for the professional technical groups and the crafts in this type of industry.

In terms of methodology, the design of the study also considered exploration of alternate populations, for comparative purposes, which included siblings and the 1% Continuous Work History Sample (ICWHS). The siblings approach was discontinued because of the large numbers that could not be identified. Similarly, there were inherent problems with the 1% ICWHS. In the analysis, it was determined that only an internal cohort comparison, controlling for a series of factors, would be appropriately sensitive to the effects of radiation exposure as expressed in the detailed mortality reports [Mancuso et al., 1977; Kneale et al., 1978].

Similar experiences in the literature have emphasized the importance of internal controls in the study of industrial workers in contrast to other populations.

The following is a brief description of the report tables and the methodology used to derive them.

For the disability claims, the disabling condition was coded by the SSA according to the Eighth Revision of the International Classification of Diseases (ICDA). All worker claims were analyzed without regard to whether the claim was allowed or denied; however, only the unique cause(s) of disability within a given employee's claim(s) were considered.

For mortality, the specific causes of death were also coded according to the Eighth Revision of the ICDA.

Table I provides a description of the study cohort; it illustrates the number of individuals who filed one or more disability claims. Table I distributes these individuals based upon their year of hire, race/sex, and life status.

Table II provides a similar description of the study cohort, but illustrates the number of claims filed by those individuals who are represented by Table I.

Tables III and IV provide information on selected groups of causes of disability. The frequencies found under the column headings "not on DC," "dead w/o DC,"

and "alive" represent situations wherein the disabling disease would not be available to analysis when relying solely upon death certificates.

Tables V and VI provide similar information as found in Tables III and IV; however, they reflect a detailed inspection of the neoplasm group (ICDA 140–239). As such, they are based upon an "exact" match of the cause of disability and, when available, the cause of death.

It is important to note that Tables III through VI reflect a reduction of the database as summarized by Tables I and II. This reduction was performed so as to be as conservative as possible. A detailed inspection of the death certificates of those employees with a neoplasm as a cause of disability revealed a number of ambiguous situations. As a result, a total of 16 disability causes were removed from the database, 14 pertaining to white males and 2 pertaining to white females.

These disability claim causes identified by cancer sites are listed below to illustrate certain aspects of disability coding at that point in time, as well as their contribution.

Disability Claim Causes Identified by Cancer Sites

Disability cause—ICDA	Reason for exclusion (discrepancies by disability or DC)
White males	
Tongue—141.0	DC-161—Cancer of larynx for 6 years (involvement of tongue probably an extension from larynx)
Tonsils 146.0	DC-144.0—Recurrent cancer of mouth with metastases
Rectum 154.0	DC-153.8—Cancer of colon with metastases for 5 years DC-153.8—Metastatic cancer of colon
Lung—162.0	DC-153.8—Metastatic cancer of colon
Bladder—188.0	DC-156.0—Cancer of gall bladder
Kidney—189.1	DC-188.0—Cancer of bladder for 8 years
Brain—191.0	DC-192—Correct coding
Central nervous system—192.9	DC-191—Correct coding
Central nervous system—192.9	DC-191—Correct coding
Central nervous system—192.9	DC-191—Correct coding
Central nervous system—192.0	DC-162—Cancer of lung with metastasis to brain
Lymphosarcoma and reticulum cell sarcoma—200.0[a]	DC-199.0—Carcinomatosis, primary site undetermined (designated by autopsy)
Lymphoma—202.0	DC-200.1—Correct coding; lymphosarcoma for 3 years
Eye-brain—238.0[b]	DC-437—Cerebrovascular disease
White Females	
Lung—162.0	DC-157.0—Cancer of pancreas with metastasis to lung
Uterine fibroma—218	Probable error in coding by disability

[a]Clinical report: metastatic malignancy from retroperitoneal source; type undetermined. Probably reticulum cell sarcoma. Identified from industrial medical records.
[b]Clinical error confirmed by autopsy.

Table VII, directed at confirmation of diagnosis, is confined to disability claim cases that are dead with death certificate. The purpose of Table VII is to show for each primary cause of death:

1. On the death certificate, was there confirmation via autopsy and/or surgery; if so, to what degree (as a percentage)?
2. Were any of the causes of disability the same as the cause of death; the degree of

sameness in Table VII is based upon an "exact" match of the respective ICDA codes, as indicated. Again, the amount of confirmation is expressed as a percentage.

Table VII was generated from the original database, prior to its aforementioned reduction.

Lastly, Tables VIII and IX provide frequency distributions of years to death from the alleged onset of disability. Because of sample size, they are restricted to white males. Table VIII illustrates the situation for all causes of disability (grouped) while Table IX is concerned with site-specific neoplasms. Because these tables are independent of death certificate information, they were generated from the original (prereduction) database.

All Tables, together with the information in this section, provide an overview of what has been observed and an indication of the necessary approaches to the data that might be developed in their application to epidemiological studies.

Findings

Table I provides a description of the study cohort; it illustrates the number of individuals who filed one or more disability claims. The table distributes these individuals based upon their year of hire, race/sex, and life status. For example, a total of 469 white male employees who were hired in 1944 filed claims. Of these, 222 are alive, 6 are dead without a death certificate, and 241 are dead with a death certificate. Similar information is provided for each of the succeeding years, with the largest numbers directly related to the start up period of operations. The total number of white males that filed disability claims was 1,333 and for white females, 278.

Table II provides a similar description of the study cohort, but illustrates the number of claims filed by those individuals who are represented by Table I. Again, for the white male employees hired in 1944, a total of 616 claims were filed by these employees. Of these claims, 311 were filed by those employees who are alive, 10 were filed by those who are dead without a death certificate, and 295 were filed by those who are dead with a death certificate.

The pattern of distribution of the claims filed in succeeding years reflects the number of employees and the latent period of the cause of disability. The white males hired from 1944–1948 inclusive filed 1,249 claims. The total number of claims filed for the white males was 1,734 and for white females 382.

Tables III and IV (white males and females) provide data on causes of disability and causes of death, designated by the same group ICD code, "exact" match (first three digits).

It is readily apparent that for certain types of diseases, the death certificate (as in any epidemiological study of industrial workers) provides a gross underestimate of the biological effects which may have occurred in that population. For example, in the study of respiratory diseases in an industrial population, mortality statistics may not include over 75% of the cases of emphysema for the white male population. Similarly, for industrial studies where chemicals may include a risk to mental disorders and diseases of the central nervous system, the death certificate would be a poor indication of such effects, with over 90% of the cases not available by the death certificate.

Tables V and VI (white males and females) provide similar information by

TABLE I. Employees With Disability Claim(s): Life Status by Year of Hire*

	Number of individuals							
	White males				White females			
Hire year	Alive	Dead w/o DC	Dead w/DC	Total	Alive	Dead w/o DC	Dead w/DC	Total
1943	1	0	1	2	0	0	0	0
1944	222	6	241	469	37	2	11	50
1945	60	2	88	150	21	1	8	30
1946	23	2	21	46	9	0	1	10
1947	91	1	79	171	27	1	5	33
1948	76	0	57	133	40	3	8	51
1949	14	0	9	23	7	1	2	10
1950	18	0	9	27	10	1	1	12
1951	63	0	46	109	23	0	3	26
1952	25	1	23	49	11	0	3	14
1953	15	0	9	24	6	0	3	9
1954	24	0	11	35	6	0	0	6
1955	10	0	13	23	3	0	1	4
1956	7	0	3	10	4	0	0	4
1957	2	0	0	2	1	0	0	1
1959	2	0	2	4	3	0	0	3
1960	3	0	0	3	1	0	0	1
1961	7	0	3	10	0	0	0	0
1962	6	0	1	7	0	0	0	0
1963	6	0	2	8	1	0	0	1
1964	0	0	0	0	1	0	1	2
1965	1	0	3	4	1	0	0	1
1966	6	0	1	7	2	0	0	2
1967	2	0	1	3	3	0	2	5
1968	4	0	0	4	2	0	0	2
1969	2	0	1	3	1	0	0	1
1970	1	0	0	1	0	0	0	0
1971	4	0	0	4	0	0	0	0
1972	2	0	0	2	0	0	0	0
Total	697	12	624	1,333	220	9	49	278

*w/o DC, without death certificate; w/DC, with death certificate.

specific cancer sites within the neoplasm ICD group, with "exact" match (first three digits). The percentage of cases not available by the death certificates was high for the respective cancer sites.

In epidemiological studies directed at occupational cancer, the contribution of a relatively few cancers of specific sites may significantly add to the findings.

Within this context, it must be remembered that the disability claims are not filed by all workers with a specific disease, but rather by a portion of the population who have the disease and have to meet certain Social Security disability criteria.

The epidemiological significance of the specific cancers identified from disability data relates to the specific type of prior occupational or environmental exposure. In the nuclear industry, representing the present study, tissues sensitive to radiation would be of particular concern, and the same principle would also apply to specific chemical industries and other types.

TABLE II. Employees With Disability Claim(s): Life Status by Year of Hire*

	Number of claims							
	White males				White females			
Hire year	Alive	Dead w/o DC	Dead w/DC	Total	Alive	Dead w/o DC	Dead w/DC	Total
1943	1	0	1	2	0	0	0	0
1944	311	10	295	616	51	3	12	66
1945	76	2	108	186	29	1	8	38
1946	35	2	24	61	13	0	2	15
1947	116	1	88	205	35	3	5	43
1948	109	0	72	181	54	3	12	69
1949	25	0	10	35	7	1	2	10
1950	22	0	15	37	14	1	1	16
1951	97	0	57	154	35	0	3	38
1952	33	1	28	62	18	0	4	22
1953	20	0	10	30	9	0	4	13
1954	32	0	12	44	13	0	0	13
1955	11	0	16	27	4	0	1	5
1956	7	0	6	13	8	0	0	8
1957	3	0	0	3	2	0	0	2
1959	2	0	2	4	4	0	0	4
1960	3	0	0	3	1	0	0	1
1961	12	0	4	16	0	0	0	0
1962	6	0	2	8	0	0	0	0
1963	7	0	2	9	1	0	0	1
1964	0	0	0	0	1	0	4	5
1965	1	0	4	5	1	0	0	1
1966	11	0	1	12	3	0	0	3
1967	2	0	2	4	3	0	2	5
1968	5	0	0	5	3	0	0	3
1969	2	0	2	4	1	0	0	1
1970	1	0	0	1	0	0	0	0
1971	4	0	0	4	0	0	0	0
1972	3	0	0	3	0	0	0	0
Total	957	16	761	1,734	310	12	60	382

*w/o DC, without death certificate; w/DC, with death certificate.

It is evident that disability data can critically enhance the identification of the specific tissues affected and the magnitude of risk in an occupational cancer mortality study.

Confirmation of Diagnosis by Disability for Cancer Sites

The pattern is that disability does contribute significantly to confirmation of diagnosis, independent of the category of no record on the death certificate relative to autopsy or surgery in categories 140–209.

Table VII shows the relationship of primary cause on the death certificate and disability claim diagnosis as source of confirmation of diagnosis, together with autopsy and surgery information.

TABLE III. Selected Cause of Disability vs. Cause of Death for White Males: All Disability Causes, All Death Causes, Exact Match*

Cause of disability		No. of Occurrences	Dead with DC: No. on DC	Dead with DC: No. not on DC	Dead w/o DC	Alive	% confirmed by DC	% N/A by DC
000–136	Infectious/parasitic disease	27	—	11	—	16	—	100.0
140–239	Neoplasms	63	35	11	2	15	55.6	44.4
250	Diabetes	50	21	13	2	14	42.0	58.0
280–289	Blood diseases	8	—	5	—	3	—	100.0
290–315	Mental disorders	233	1	77	9	146	.4	99.6
320–389	Nervous system diseases	162	6	51	2	103	3.7	96.3
390–458	Circulatory system diseases	527	101	184	3	239	19.2	80.8
492	Emphysema	118	24	47	1	46	20.3	79.7
520–577	Digestive system diseases	102	8	39	—	55	7.8	92.2
580–629	Genitourinary system diseases	25	2	13	—	10	8.0	92.0
680–709	Skin diseases	14	—	6	—	8	—	100.0
710–738	Musculoskeletal system diseases	417	4	120	—	293	1.0	99.0
800–999	External causes	129	—	34	3	92	—	100.0

*DC, death certificate; w/o DC, without death certificate.

TABLE IV. Selected Cause of Disability vs. Cause of Death for White Females: All Disability Causes, All Death Causes, Exact Match*

Cause of disability		No. of Occurrences	Dead with DC: No. on DC	Dead with DC: No. not on DC	Dead w/o DC	Alive	% confirmed by DC	% N/A by DC
000–136	Infectious/parasitic disease	8	—	3	—	5	—	100.0
140–239	Neoplasms	15	8	—	2	5	53.3	46.7
250	Diabetes	11	2	3	—	6	18.2	81.8
280–289	Blood diseases	3	—	—	1	2	—	100.0
290–315	Mental disorders	67	—	9	1	57	—	100.0
320–389	Nervous system diseases	44	1	7	1	35	2.3	97.7
390–458	Circulatory system diseases	64	4	10	4	46	6.3	93.8
492	Emphysema	9	2	3	—	4	22.2	77.8
520–577	Digestive system diseases	24	2	3	1	18	8.3	91.7
580–629	Genitourinary system diseases	7	—	1	1	5	—	100.0
680–709	Skin diseases	6	—	1	—	5	—	100.0
710–738	Musculoskeletal system diseases	97	1	5	2	89	1.0	99.0
800–999	External causes	23	—	1	—	22	—	100.0

*DC, death certificate; w/o DC, without death certificate.

For cancer sites (140–149) for the death cases, prior disability diagnoses increased the autopsy percentage of confirmation from 40%–80%.

For cancer site 150, disability confirmation was 33.3% and autopsy confirmation was 66.7%.

For cancer site 151, the disability confirmation raised the autopsy percentage of 33.3%–83.3%.

TABLE V. Selected Cause of Disability vs. Cause of Death for White Males: All Disability Causes, All Death Causes, Exact Match*

Cause of disability: neoplasms	No. of occurrences	Dead with DC: No. on DC	Dead with DC: No. not on DC	Dead w/o DC	Alive	% confirmed by DC	% N/A by DC
141 Tongue	1	1	—	—	—	100.0	—
142 Parotid gland	1	1	—	—	—	100.0	—
150 Esophagus	1	1	—	—	—	100.0	—
151 Stomach	3	3	—	—	—	100.0	—
153 Large intestine ex. rectum	4	3	—	—	1	75.0	25.0
154 Rectum	2	1	1	—	—	50.0	50.0
157 Pancreas	3	3	—	—	—	100.0	—
160 Nose-nasal cavities	2	1	—	—	1	50.0	50.0
161 Larynx	5	1	2[a]	—	2	20.0	80.0
162 Lung	16	10	2	1	3	62.5	37.5
170 Bone	1	1	—	—	—	100.0	—
173 Skin	2	—	2	—	—	—	100.0
185 Prostate	4	3	—	—	1	75.0	25.0
188 Bladder	3	1	2	—	—	33.3	66.7
189 Kidney	1	1	—	—	—	100.0	—
192 Nervous system	1	—	1	—	—	—	100.0
200 Lymphosarcoma/reticulum cell	2	2	—	—	—	100.0	—
202 Lymphoma	2	1	—	—	1	50.0	50.0
203 Multiple myeoma	2	1	—	1	—	50.0	50.0
208 Polycythemia vera	3	—	1	—	2	—	100.0
213 Bone (benign)	1	—	—	—	1	—	100.0
225 Brain (benign)	3[b]	—	—	—	3	—	100.0
Total	63	35	11	2	15	55.6	44.4

*DC, death certificate; w/o DC, without death certificate.
[a]Not as primary.
[b]One case coded 225 and 192.

TABLE VI. Selected Cause of Disability vs. Cause of Death for White Females: All Disability Causes, All Death Causes, Exact Match*

Cause of disability: neoplasms	No. of occurrences	Dead with DC: No. on DC	Dead with DC: No. not on DC	Dead w/o DC	Alive	% confirmed by DC	% N/A by DC
157 Pancreas	1	1	—	—	—	100.0	—
162 Lung	1	1	—	—	—	100.0	—
174 Breast	5	2	—	1	2	40.0	60.0
180 Cervix	3	2	—	—	1	66.7	33.3
183 Ovary	2	1	—	1	—	50.0	50.0
197 Unspecified	1	1	—	—	—	100.0	—
201 Hodgkin's disease	1	—	—	—	1	—	100.0
203 Multiple myeloma	1	—	—	—	1	—	100.0
Total	15	8	0	2	5	53.3	46.7

*DC, death certificate; w/o DC, without death certificate.

TABLE VII. Cause of Death Vs. Cause of Disability as Confirmation Using All Claims

ICDA grouping	Case no.	Death cause	Surgery/autopsy	Disability cause	Total confirmed
140–149	E-005	141.0	—	141.9	
	E-006	142.9	Autopsy	142.9	
	E-007	145.9	—	146.0	
	E-008	146.0	—	—	
	E-009	149.	Autopsy	—	
	Total(%)	5	2(40.0)	3(60.0)	4(80.0)
150	E-010	150.X	Autopsy	—	
	E-011	150.X	—	—	
	E-012	150.X	Surgery	150.X	
	Total(%)	3	2(66.7)	1(33.3)	2(66.7)
151	E-013	151.9	—	—	
	E-014	151.9	Autopsy	—	
	E-015	151.9	—	151.9	
	E-016	151.9	—	151.X	
	E-017	151.9	—	151.9	
	E-018	151.9	Autopsy	—	
	Total(%)	6	2(33.3)	3(50.0)	5(83.3)
153–154	E-019	153.3	—	—	
	E-020	153.3	Autopsy	—	
	E-021	153.3	—	153.9	
	E-022	153.3	—	—	
	E-023	153.8	—	154.1	
	E-024	153.8	Surgery	—	
	E-025	153.8	—	154.1	
	E-026	153.8	—	153.8	
	E-027	153.8	—	—	
	E-028	153.8	—	153.8	
	E-029	153.8	Surgery	—	
	E-030	154.1	Surgery/autopsy	—	
	E-031	154.1	Autopsy	154.1	
	Total(%)	13	5(38.5)	6(46.2)	10(76.9)
155–156	E-032	155.0	—	—	
	E-033	156.0	—	—	
	E-034	156.1	Surgery	—	
	Total(%)	3	1(33.3)	0(0.0)	1(33.3)
157					
	E-035	157.0	Surgery	—	
	E-036	157.8	Autopsy	—	
	E-037	157.9	—	—	
	E-038	157.9	Autopsy	—	
	E-039	157.9	Autopsy	—	
	E-040	157.9	Surgery	—	
	E-041	157.9	—	157.9	
	E-042	157.9	—	—	
	E-043	157.9	—	157.9	
	E-044	157.9	—	157.9	
	E-045	157.X	—	157.9	
	Total(%)	11	5(45.5)	4(36.4)	9(81.8)

(continued)

TABLE VII. Cause of Death vs. Cause of Disability as Confirmation Using All Claims (Continued)

ICDA grouping	Case no.	Death cause	Surgery/autopsy	Disability cause	Total confirmed
160–161	E-046	160.8	—	160.8	
	E-047	161.9	—	—	
	E-048	161.9	—	161.9	
	Total(%)	3	0(0.0)	2(66.7)	2(66.7)
162	E-049	162.1	Autopsy	—	
	E-050	162.1	Surgery	—	
	E-051	162.1	Autopsy	162.1	
	E-052	162.1	Autopsy	—	
	E-053	162.1	—	—	
	E-054	162.1	—	—	
	E-055	162.1	—	—	
	E-056	162.1	—	162.1	
	E-057	162.1	—	—	
	E-058	162.1	—	—	
	E-059	162.1	—	—	
	E-060	162.1	Autopsy	—	
	E-061	162.1	Surgery	—	
	E-062	162.1	—	162.1	
	E-063	162.1	—	—	
	E-064	162.1	—	162.1	
	E-065	162.1	—	—	
	E-066	162.1	—	162.1	
	E-067	162.1	—	—	
	E-068	162.1	—	162.1	
	E-069	162.1	—	162.1	
	E-070	162.1	—	—	
	E-071	162.1	—	—	
	E-072	162.1	—	—	
	E-073	162.1	—	—	
	E-074	162.1	Autopsy	—	
162	E-075	162.1	—	162.1	
	E-076	162.1	—	—	
	E-077	162.1	Autopsy	—	
	E-078	162.1	—	—	
	E-079	162.1	—	—	
	E-080	162.1	Autopsy	—	
	E-081	162.1	Surgery	—	
	E-082	162.1	Autopsy	—	
	E-083	162.1	—	—	
	E-084	162.1	—	—	
	E-085	162.1	Autopsy	—	
	E-086	162.1	—	—	
	E-087	162.1	—	—	
	E-088	162.1	—	—	
	E-089	162.1	—	162.1	
	E-090	162.1	—	—	
	E-091	162.1	—	162.1	
	E-092	162.X	—	162.1	
	Total(%)	44	12(27.3)	11(25.0)	22(50.0)
170	E-093	170.6	Autopsy	170.2	
	Total(%)	1	1(100.0)	1(100.0)	1(100.0)

(continued)

TABLE VII. Cause of Death vs. Cause of Disability as Confirmation Using All Claims (Continued)

ICDA grouping	Case no.	Death cause	Surgery/autopsy	Disability cause	Total confirmed
174	E-094	174.X	—	—	
	E-095	174.X	—	174.X	
	E-096	174.X	—	—	
	E-097	174.X	—	174.X	
	Total(%)	4	0(0.0)	2(50.0)	2(50.0)
180	E-098	180.X	—	180.X	
	E-099	180.X	—	180.X	
	Total(%)	2	0(0.0)	2(100.0)	2(100.0)
183	E-100	183.0	—	183.0	
	E-101	183.0	—	—	
	Total(%)	2	0(0.0)	1(50.0)	1(50.0)
185	E-102	185.X	—	—	
	E-103	185.X	—	—	
	E-104	185.X	—	185.X	
	E-105	185.X	—	—	
	E-106	185.X	—	185.X	
	E-107	185.X	—	—	
	E-108	185.X	Autopsy	—	
	E-109	185.X	—	—	
	E-110	185.X	Surgery	—	
	E-111	185.X	—	—	
	Total(%)	10	2(20.0)	2(20.0)	4(40.0)
187	E-112	187.0	—	—	
	Total(%)	1	0(0.0)	0(0.0)	0(0.0)
188	E-113	188.X	—	188.X	
	E-114	188.X	Surgery	—	
	E-115	188.X	—	—	
	Total(%)	3	1(33.3)	1(33.3)	2(66.7)
189	E-116	189.0	Autopsy	—	
	E-117	189.0	Surgery	189.0	
	E-118	189.0	Surgery/autopsy	—	
	Total(%)	3	3(100.0)	1(33.3)	3(100.0)
191–192	E-119	191.X	—	192.9	
	E-120	191.X	Autopsy	192.9	
	E-121	191.X	Autopsy	192.9	
	E-122	191.X	—	—	
	E-123	192.1	—	191.X	
	Total(%)	5	2(40.0)	4(80.0)	4(80.0)
200–201	E-131	200.0	—	200.0	
	E-132	200.1	Autopsy	200.0	
	E-133	200.1	—	—	
	E-134	201.X	—	—	
	Total(%)	4	1(25.0)	2(25.0)	2(50.0)
202	E-135	202.2	Surgery/autopsy	202.0	
	Total(%)	1	1(100.0)	1(100.0)	1(100.0)
203	E-136	203.X	—	203.X	
	Total(%)	1	0(0.0)	1(100.0)	1(100.0)
205–209	E-137	205.0	—	—	
	E-138	205.1	—	—	
	E-139	207.0	—	—	
	E-140	208.X	—	—	
	E-141	209.9	Autopsy	—	
	Total(%)	5	1(20.0)	0(0.0)	1(20.0)

For cancer sites 153 and 154, the disability confirmation raised the autopsy surgery confirmation from 38.5%–76.9%.

For cancer sites 155 and 156, there were no additional confirmation of diagnoses for the records available at this time; it remained at 33.3%.

For cancer site 157, the disability diagnosis raised the percentage of autopsy confirmation from 45.5%–81.8%.

For cancer sites 160–161, the disability diagnosis raised the autopsy percentage of 0%–66.7%.

For cancer site 162, the disability confirmation raised the autopsy surgery percentage of 27.3%–50.0%.

For cancer site 170, with one case, the percentage of confirmation was the same, 100%.

For cancer site 174, the disability confirmation raised the autopsy surgery percentage from 0%–50.0%.

For cancer site 180, the disability diagnosis raised the autopsy surgery percentage from 0%–100%.

For cancer site 183, the disability diagnosis raised the autopsy surgery percentage from 0%–50.0%.

For cancer site 185, the disability diagnosis raised the autopsy surgery percentage from 20%–40%.

For cancer site 188, the disability diagnosis raised the autopsy surgery percentage from 33.3%–66.7%.

For cancer site 189, the percentage of confirmation was 100% for autopsy, surgery, and disability data.

For cancer site 191 and 192, the disability confirmation raised the autopsy surgery percentage from 40%–80%.

For cancer sites 200 and 201, the disability confirmation raised the percentage of autopsy surgery from 25%–50%.

For cancer site 202 for one case, the confirmation of diagnosis was 100% for both death and disability data.

For cancer site 203 for the one case, the disability confirmation raised the percentage from 0%–100%.

For neoplasms 205–209, the percentage of confirmation remained the same 20%.

Interval in Years Between Disability and Death

Summary Table VIII refers to the interval in years between the alleged data of onset of disability and date of death. For the respective causes of disability, the Table shows the percentage of cases in designated intervals of time between disability and death, for white males using all claims.

Although the presentation is by categories of disease, the disability data can be readily applied to specific causes, including those representing occupational health effects, as the basis for consideration of long range medical costs.

Table VIII clearly demonstrates that the shortest interval between the disability claim and cause of death occurs for category 140–239 neoplasms; 62.7% occurred 1 year after the claim was filed.

All the other disease categories had relatively long latent periods, as evident in the combination of 6–10 years and 10 years or more. The highest combinations were

TABLE VIII. Cause of Disability vs. Years of Death: Employees (White Males) Using All Claims*

Cause of disability	<1 year		1 year		2 years		3–5 years		6–10 years		>10 years		
	N	%	N	%	N	%	N	%	N	%	N	%	Total
000–136	1	9.1		(—)		—	2	18.2	1	9.1	7	63.6	11
140–239	25	37.3	17	25.4	10	14.9	5	7.5	5	7.5	5	7.5	67
250	2	5.9	5	14.7	3	8.8	7	20.6	13	38.2	4	11.8	34
280–289		—	1	20.0		—	1	20.0	2	40.0	1	20.0	5
290–315	4	5.1	4	5.1	4	5.1	15	19.2	22	28.2	29	37.2	78
320–389	1	1.8	3	5.4	2	3.6	8	14.3	17	30.4	25	44.6	56
390–458	13	4.7	23	8.2	19	6.8	58	20.8	89	31.9	77	27.6	279
492	4	5.7	5	7.1	7	10.0	14	20.0	28	40.0	12	17.1	70
520–577	2	4.3	1	2.1		—	6	12.8	21	44.7	17	36.2	47
580–629	3	20.0	1	6.7	1	6.7	2	13.3	2	13.3	6	40.0	15
680–709		—	1	16.7		—	1	16.7	2	33.3	2	33.3	6
710–738	1	0.8	5	4.1	5	4.1	24	19.7	42	34.4	45	36.9	122
800–999		—		—	1	2.9	4	11.8	11	32.4	18	52.9	34

*A total of 10 cases (causes of disability) have been eliminated owing to unavailable/erroneous dates contained within the respective claim records. A breakdown of these cases is as follows: 320–389 (1); 390–458 (6); 492 (1); 710–738 (2).

TABLE IX. Cause of Disability vs. Years of Death: Employees (White Males) Using All Claims*

Cause of disability	<1 year		1 year		2 years		3–5 years		6–10 years		>10 years		
	N	%	N	%	N	%	N	%	N	%	N	%	Total
140–149		—	3	75.0	1	25.0		—		—		—	4
150		—	1	100.0		—		—		—		—	1
151	2	66.7	1	33.3		—		—		—		—	3
152		—		—		—		—		—		—	0
153–154	3	42.9	1	14.3	1	14.3	1	14.3		—	1	14.3	7
155–156		—		—		—		—		—		—	0
157	2	66.7	1	33.3		—		—		—		—	3
160–161		—	1	25.0		—	1	25.0		—	2	50.0	4
162	7	53.8	2	15.4	3	23.1		—		—	1	7.7	13
170	1	100.0		—		—		—		—		—	1
171		—		—		—		—		—		—	0
172		—		—		—		—		—		—	0
173	1	50.0		—		—		—		—	1	50.0	2
174		—		—		—		—		—		—	0
180		—		—		—		—		—		—	0
183		—		—		—		—		—		—	0
185	1	33.3		—		—		—	2	66.7		—	3
187		—		—		—		—		—		—	0
188		—	2	50.0		—	1	25.0	1	25.0		—	4
189	1	50.0		—		—		—	1	50.0		—	2
191–192	3	60.0	1	20.0	1	20.0		—		—		—	5
195		—		—		—		—		—		—	0
196		—		—		—		—		—		—	0
197–199	3	50.0	2	33.3		—	1	16.7	—	—		—	6
200–201	2	66.7	1	33.3		—		—		—		—	3
202		—		—	1	50.0		—	1	50.0		—	2
203		—		—		—	1	100.0		—		—	1
204		—		—		—		—		—		—	0
205–209		—		—	2	100.0		—		—		—	2
210–239		—		—	1	100.0		—		—		—	1

*Restricted to disability cases that are dead with D.C. All causes of disability investigated.

for (000–136) infectious disease, tuberculosis, etc. 72.7%; for (290–315) mental disorders, 65.4%; for (320–389) nervous systems, 75.0%; for (710–738) musculoskeletal, arthritis, etc. 71.3%; for (800–999) accidents, poisonings, and violence, 85.3%.

Table VIII also demonstrates how early these diseases could have been anticipated prior to death, as part of any evaluation of the industrial population.

It further indicates a means to estimate cost analyses of medical care for respective disease disability claims as demonstrated by Bye et al. [1987].

Table IX provides a further refinement in the presentation of interval from alleged date of onset of disability and death for specific causes in the neoplasms category (140–239). Although the subdivision for such a large span of specific causes provides very small numbers, nevertheless, they do accent the pattern for those who died within 1 year and show, for some, the exceptions where cause of death can and has occurred much later. In Table IX code causes 150, 151, 157, 200, and 201 for all deaths were within 1 year. The cancer sites exceptions that occurred for intervals

6–10 years were 185, 188, 189, and 202. For the interval 10 years or more, exceptions occurred for 153–154, 160–161, 162, and 173.

For each of the respective diseases for which claims are filed for disability, it is evident that the disease could exist for a prolonged period of time before a disability claim was filed.

DISCUSSION

Mortality

As background, reference will be made to a series of earlier steps in methodology that had been taken in the development of the application of the national data resources of the Social Security system in the study of environmental health effects. These studies, directed at mortality and differential causes of death, subsequently led to the necessity of more sensitive determinates of health effects, the utilization of the Social Security disability data.

Historically, there were two interrelated basic problems: the usually long latent period for cancer which could span 40 or more years, and the inability to establish retrospectively the employee population at risk in specific prior decades because the employee records for individual plants were usually destroyed during the intervening years.

It was necessary to evolve a methodology that was national in scope; that was accurate and complete with uniform employment records of all industries; that would provide the means to followup and trace the employees over decades regardless of their place of death; and that was economically feasible. Then, again, the method had to have the capability of reproducibility; that is, any other investigator could conduct the same study using the same data and derive the same results.

This objective led to the initial development of the Social Security approach by Mancuso and Coulter [1959] as a unique national resource for prospective studies, to identify and establish cohorts of employee populations at any given point in time from 1937 for any company or employer in the United States covered by Social Security and to follow this cohort prospectively regardless of migration or place of death to the present.

The feasibility of the Social Security system for the retrospective identification of cohorts of workers in a specific company was again demonstrated by Mancuso and Coulter [1963]. In a cohort study of workers engaged in the manufacture of asbestos products, the potential linkage through the common use of the Social Security number with other sources of data, for which other variables had been established, was cited.

Ciocco et al. [1965] demonstrated the use of the Social Security data in the consideration of the interrelation of mortality, earnings level, and work experience for a segment of the U.S. working population, establishing the basis for future epidemiological studies along these lines. In the characterization of the cohorts from Social Security, the earnings level is available by case number on the living and the deceased, so that the variable can be considered in prospective studies.

Taylor [1966] extended the methodology to include the characteristic of "duration" as furnished by Social Security, in terms of length of employment in the same company.

In a restudy of the plant manufacturing betanaphthlyamine and benzidine, the reproducibility of observations through the Social Security approach, as well as the

means to test further earlier epidemiological leads relative to specific cancer sites, was demonstrated [Mancuso and El-Attar, 1967].

Throughout all of these cohort prospective studies, there remained the problem of a better definition of the employee population at risk, in order to alleviate the dilution effect of using the total company population in the determination of the magnitude and scope of the health effects.

It was learned that during the 1940s, a considerable number of the companies submitted their quarterly employee payroll listings to Social Security in a manner which allowed for identification as to office and nonoffice. This provided the first means to divide the total company population in a comparison between office and production workers.

This led to the next development methodology [Mancuso et al., 1968], the linkage of the Social Security office-nonoffice data of a specific company with another record source, the company union records. These provided the identification of each department process and the specific employees by name and social security number, which provided the basis for departmental comparisons.

Another capability of the Social Security system was demonstrated [Mancuso and El-Attar, 1969] with the establishment of successive cohorts, each new employee characterized by year of hire with employment in the respective company, grouped by designated years as a separate cohort, e.g., 1937–1939, 1940, 1941, etc., covering a span of employment experience defined for each quarter of the year from 1937–1948. The objective of this methodology was to provide a means of identifying and confirming an environmental problem by the consistency with which an identical biological effect follows upon exposure to the same environmental agent over the same period of time. It also reflects differences in exposure in different time periods with changes in manufacturing processes, and serves as a biological index of the effectiveness of environmental control measures.

Disability

In all of these cohort studies previously mentioned, the search for the biological effects has been in terms of mortality experience. Yet it is well known that the primary and secondary causes of death on the death certificate do not reflect the diseases or illnesses which may have occurred prior to death from which the individual may have recovered, or which may not be recognized as a contributing cause of death and therefore not recorded on the death certificate. The consequences have been the underestimation of the true nature and magnitude of occupational health effects when based solely on death certificates.

The Social Security disability data constitute the equivalent national uniform resource on morbidity which can meet this need to a significant extent, and provide the means for the simultaneous cohort study of mortality and disability from the same source, the Social Security system, for the industrial populations of the respective companies.

Similarly, the refinements achieved in the development of the cohort mortality approach can now be applied to disability data so that both mortality and morbidity can be evaluated, potentially by office and nonoffice; year of hire; duration of employment; and departmental designations for successive cohorts, as well as by specific crafts.

The national adoption by hospital and medical systems of the Social Security

number for identification complements the means to determine prior to death, the antecedent sequence of illness and disease, of populations under study for long-term delayed biological effects due to environmental agents.

In terms of the development of the methodology for the study of industrial populations, the potential now exists for linkage through the Social Security number of the in-plant industrial medical and environmental exposure data during employment with subsequent disability after separation from employment and with Medicare following retirement, and finally by cause of death.

The linkage of the medical records of clinical diagnosis and mortality from the Medicare[1] system represents potentially the most extensive national advancement for the development of long-term epidemiological studies, in particular the study of occupational cancer and other health effects among the elderly.

It is hoped that other research investigators will explore and develop the application of both disability claim and Medicare data on illness and disease as essential components in cohort studies of industrial populations.

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[1]In order to reimburse health care providers (including hospitals), in most states, Blue Cross is the fiscal intermediary and Blue Shield the carrier for the Health Care Financing Administration (HCFA) of the Social Security system; commercial insurance companies are the fiscal intermediaries or carrier in the other states. The linkage therefore exists for the data collection and integration of hospital payments and medical records with the Social Security system.

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