Exhibit 322

An Updated Mortality Study of Workers at a Petroleum Refinery in Beaumont, Texas, 1945 to 1996

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The present investigation represents an update of a previous cohort mortality study of 7543 workers who were employed at a petroleum refinery in Beaumont, Texas, for at least 1 year between 1945 and 1996. The updated study covered an observation period of 51 years, from 1946 to 1996, with a total of 208,627 person-years of observation. A total of 3020 (40.0%) cohort members were known to have died. The mortality data were analyzed in terms of cause-specific standardized mortality ratios (SMRs) and 95% confidence intervals (95% CIs). The overall mortality of the cohort was significantly lower than expected when compared with that of the general US population (SMR, 95.7; 95% CI, 92.3 to 99.2). Overall cancer mortality was also lower than expected (SMR, 85.8; 95% CI, 79.4 to 92.5). For specific cancer sites, significant mortality deficits were observed for the following: buccal cavity and pharynx, esophagus, large intestine, rectum, larynx, lung, and bladder and other urinary organs. No significant increase was reported for any site-specific cancer. A non-significant increase in acute myeloid leukemia was observed among male employees (SMR, 147.2; 95% CI, 76.1 to 257.2). Detailed analyses indicated that the excess was restricted to workers hired before 1950. No increase was detected for other leukemia cell-types, non-Hodgkin's lymphoma, or multiple myeloma. For non-malignant diseases, the majority of SMRs were below 100, and no significant increase was observed for any cause. In particular, significant mortality deficits were reported for ischemic heart disease (SMR, 91.0; 95% CI, 85.4 to 96.9), non-malignant respiratory disease (SMR, 61.5; 95% CI, 52.2 to 72.0), pulmonary fibrosis (SMR, 51.0; 95% CI, 22.0 to 100.4), cirrhosis of the liver (SMR, 47.2; 95% CI, 30.6 to 69.7), and accidents (SMR, 81.7; 95% CI, 66.3 to 99.6). Separate analyses of male workers by job classification (process and maintenance) were conducted. Mortality from acute myeloid leukemia was elevated among employees in maintenance jobs (8 observed deaths vs 4.31 expected; SMR, 185.5; 95% CI, 80.1 to 365.6). However, no upward trend by length of service was found. A detailed analysis indicated that the acute myeloid leukemia mortality excess was limited to maintenance workers who were hired before 1950. No other significant excess was detected for any cause among maintenance or process workers. These findings from the present study were discussed in conjunction with results from previous investigations of employees at the Beaumont refinery and with results from other refinery studies. Potential limitations of the study were also discussed. (J Occup Environ Med. *2001;43:384–401*)

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Refinery workers are potentially exposed to a wide range of petroleum-derived hydrocarbons and chemical substances used in the manufacturing of petroleum fuels and lubricants. Specific substances in the working environment of petroleum refineries, previously identified by the International Agency for Research on Cancer, include aromatic amines (eg, anisidine), arsenic compounds, asbestos, benzene, bitumens, butadiene, carbazole, chlorinated hydrocarbons, chromium and chromium compounds, ethylene dibromide, ethylene dichloride, hydrazine, lead and lead compounds, mineral oils, nickel and nickel compounds, phenylenediamine, polycyclic aromatic compounds, and silica.[1]

The Mobil (now ExxonMobil) Beaumont, Texas, refinery has been operating since 1902 and is one of the oldest and largest full-service refineries in the United States. The refinery processes approximately 350,000 barrels of oil per day and produces a variety of petroleum products, including gasoline, diesel fuels, fuel oils, jet fuel, kerosene, liquefied petroleum gas, asphalt, lubricating oil and greases, and feedstocks for the petrochemical industry.

In 1984, Morgan and Wong[2] completed a retrospective cohort mortality study of workers at the Beaumont refinery who had worked for at least 1 year between January 1, 1945, and December 31, 1978. The vital status of these workers was ascertained through December 31, 1978. The

cohort study was subsequently updated and expanded to include all employees at the refinery who had worked for at least 1 year between January 1, 1945, and December 31, 1987, with vital status follow-up extended to December 31, 1987.[3] In addition to the cohort study, a nested case-control study of lung cancer was also conducted.[4]

The objective of the present investigation was to update and expand the previous cohort study and to continue monitoring the mortality patterns of the Beaumont refinery workers. In the present update, enrollment in the study was extended to cover an additional 9 years of employment eligibility (1988 to 1996). Vital status follow-up was extended from 1987 to 1996.

Subjects and Methods

The expanded cohort consisted of all Mobil employees who had worked for at least 1 year at the Beaumont refinery between January 1, 1945, and December 31, 1996. The cohort members were identified through a combination of personnel records located on-site and computerized payroll files. Information abstracted from these records included social security number, name, gender, race, date of birth, date of employment, employment status on the closing date of the study, vital status on the closing date of the study, and date of retirement, separation, or death when applicable. Employment histories of individuals in the previous cohort were updated from 1987 to 1996. For each employee, the employment history data consisted of the beginning and ending dates for each job, job titles, and departments.

The vital status of cohort members as of December 31, 1996, was ascertained through several sources, including company employment or retirement records, records at Pension Benefits Information, Inc, the Social Security Administration's Death Master File, and the National Center for Health Statistics' (NCHS) National Death Index (NDI). The Death Master File is a national database of all deaths reported to the Social Security Administration since 1939. Vital status of an individual is ascertained by matching the last name and social security number. The NDI, established in 1979, is a national death registry designed to facilitate health investigations. Matching is based on the full name, social security number, birth date, gender, race, and, in some cases, father's surname. Vital status information and causes of death of study subjects are provided by the NDI through a service known as "NDI Plus." In the present update, the causes of death for known decedents were obtained from either NDI Plus or death certificates. The underlying and contributory causes of death were coded or converted according to the International Classification of Diseases, 8th Revision (ICD-8).

Statistical analyses were based on cause-specific standardized mortality ratios (SMRs). Person-years of observation were classified by age (5-year groups), gender, race, and calendar year (5-year groups). The race of approximately 5% cohort members was unknown, and these workers were assumed to be white in the analyses. Expected deaths were calculated by applying the US national age-, cause-, gender-, race-, and year-specific death rates to the corresponding person-years in the cohort. Cause-specific SMRs were computed by expressing the observed deaths as percentages of the expected. The actual calculation was performed through the University of Pittsburgh's OCMAP program, with standard mortality rates derived from the Mortality and Population Data System.[5] Analyses were performed for the entire cohort and for subcohorts stratified by gender, length of employment, and time since first employment at the refinery. Trend analyses by length of employment were based on the method described by Breslow and Day.[6] To investigate mortality by job category, male hourly employees at the Beaumont refinery were classified into two major job categories: (1) process workers, and (2) maintenance craftspeople. The sub-cohort of maintenance craftspeople consisted of individuals involved in a broad range of labor and maintenance activities in the mechanical and service divisions of the refinery. Examples of process units and maintenance crafts are listed in the Appendix.

In addition to analyses conducted using the routine OCMAP program, a special analysis for lymphohemopoietic malignancies was also performed. In the United States, because of the way in which mortality rates by ICD-8 categories are tabulated by the NCHS, analyses of non-Hodgkin's lymphoma (NHL) and multiple myeloma (MM) in most occupational cohort studies are generally not reported as such. In the OCMAP program, NHL (ICD-8 200 and 202) appears in two categories: "lymphosarcoma and reticulosarcoma" (ICD-8 200) and "cancer of all other lymphatic and hematopoietic tissue" (ICD-8 202, 203, 208, 209). Thus, part of NHL (ICD-8 202, "other lymphomas") is reported together with MM (ICD-8 203), polycythemia vera (ICD-8 208), and myelofibrosis (ICD-8 209). In the special analysis, NHL and MM were analyzed separately. In the OCMAP program, different types of leukemia were analyzed as one single group. Therefore, the following major types of leukemia were also analyzed separately: acute lymphatic (ICD-8 204.0), chronic lymphatic (ICD-8 204.1), acute myeloid (ICD-8 205.0), and chronic myeloid leukemia (ICD-8 205.1). US mortality rates for cell-type specific leukemias, NHL, and MM compiled by the National Cancer Institute, based on data derived from the Surveillance, Epidemiology, and End Results (SEER) program, were used in computing the expected deaths from these causes.[7,8]

Furthermore, because of the use of asbestos at the refinery in the past, separate analyses for asbestos-related diseases were also performed.

The OCMAP program did not provide a separate analysis for asbestosis. The term asbestosis refers to pulmonary fibrosis caused by exposure to asbestos, or pulmonary fibrosis in persons with a documented asbestos exposure history. Because certifying physicians might not be aware of the decedents' asbestos exposure (if any), such deaths could have been coded simply as pulmonary fibrosis or pneumoconiosis. Therefore, mortality coded as pulmonary fibrosis or pneumoconiosis (ICD-8 515–517) was analyzed. Expected deaths were based on US rates for pulmonary fibrosis obtained from the NCHS (unpublished data by special request). For malignant peritoneal or pleural mesothelioma, mortality rates compiled by the National Cancer Institute were used.[9,10]

Results

A total of 7543 workers were eligible for inclusion in the updated study (Table 1). Eighty-three percent (83.0%) of the cohort members were white (including Hispanics), and 90.6% were male. Selected employment and demographic characteristics of the cohort are provided in Table 1. More than 90% were first employed when in their thirties or younger, and only 8.4% were hired at age 40 or older. Close to half (48.3%) were hired before 1950, and more than one-third (34.3%) were employed for 30 or more years at the refinery.

The maximum length of vital status follow-up was 51 years (January 1, 1946, to December 31, 1996). The average duration of follow-up was 28 years. A total of 5012 (66.6%) cohort members had a follow-up of 20 years or more. The increase in person-years from the previous study was 42,200, or 25.4%, to a total of 208,627. By the end of the follow-up period (December 31, 1996), 1650 (21.9)% cohort members were still employed at the refinery, 2817 (38.1%) had separated or retired, and 3020 (40.0%) were known to have died. Information on vital status was

TABLE 1
Characteristics of the Beaumont, Texas, Cohort

	n	% of Total
Total employees	7,543	100.0
Total person-years	208,627	100.0
Race		
White	6,262	83.0
Non-white	1,281	17.0
Gender		
Male	6,832	90.6
Female	711	9.4
Year of hire		
<1950	3,647	48.3
≥1950	3,896	51.7
Duration of employment (yr)		
<10	1,914	25.4
10–29	3,038	40.3
30+	2,591	34.3
Age at hire		
<20	958	12.7
20–39	5,949	78.9
40+	636	8.4
Age at death		
<50	242	8.0
50–59	374	12.4
60–69	805	26.7
70+	1,599	52.9
Vital status (12/31/96)		
Alive	4,392	58.2
Dead	3,020	40.0
Unknown	131	1.7

98.3% complete, with 131 (1.7%) separated employees lost to follow-up. Of the 3020 cohort members identified to have died between 1946 and 1996, death certificate information (derived from death certificates themselves or from NDI Plus listings) was available for 98.5%. The causes of death of the remaining 1.5% deaths were unknown, and they were included in the overall SMR (all causes) calculations but not in cause-specific SMR calculations.

The number of observed deaths, SMRs, and 95% confidence intervals (CI) for selected causes for all workers are presented in Table 2. The total number of observed deaths was 3020 compared with 3155.46 expected (SMR, 95.7; 95% CI, 92.3 to 99.2), indicating a small but statistically significant deficit in overall mortality. Mortality from all cancers was also significantly lower than expected. The number of observed cancer deaths was 674, versus 786.01 expected (SMR, 85.8; 95% CI, 79.4 to 92.5).

For specific cancer sites, significant mortality deficits were observed for the following: buccal cavity and pharynx, esophagus, large intestine, rectum, larynx, lung, and bladder and other urinary organs. No significant increase was reported for any site-specific cancer. For the cohort as a whole, there was an increase of mortality from leukemia, with an SMR of 138.9 (95% CI, 98.8 to 189.9), which approached but did not reach statistical significance.

For non-malignant diseases, the majority of SMRs were below 100, and no significant increase was observed for any cause. In particular, significant mortality deficits were reported for ischemic heart disease (SMR, 91.0; 95% CI, 85.4 to 96.9), non-malignant respiratory disease (SMR, 61.5; 95% CI, 52.2 to 72.0), cirrhosis of the liver (SMR, 47.2;

TABLE 2
Cause-Specific Mortality of the Entire Cohort of Employees at the Beaumont Refinery[a]

Cause of Death	OBS	EXP	SMR	95% Confidence Limits	
				Lower	Upper
All causes of death	3,020	3,155.46	95.7*	92.3	99.2
All malignant neoplasms	674	786.01	85.8**	79.4	92.5
Cancer of buccal cavity and pharynx	5	20.13	24.8**	8.1	58.0
Cancer of digestive organs and peritoneum	157	212.60	73.8**	62.7	86.3
Cancer of esophagus	12	21.55	55.7*	28.8	97.3
Cancer of stomach	33	40.69	81.1	55.8	113.9
Cancer of large intestine	52	70.50	73.8*	55.1	96.7
Cancer of rectum	6	19.62	30.6**	11.2	66.6
Cancer of biliary passages and liver	8	15.44	51.8	22.4	102.1
Cancer of pancreas	40	40.23	99.4	71.0	135.4
Cancer of all other digestive organs	6	8.02	74.8	27.5	162.9
Cancer of respiratory system	207	254.47	81.3**	70.6	93.2
Cancer of larynx	3	10.23	29.3*	6.1	85.7
Cancer of bronchus, trachea, lung	201	241.25	83.3**	72.2	95.7
Cancer of all other respiratory	3	2.88	104.2	21.5	304.5
Cancer of breast	13	7.50	173.4	92.3	296.5
All uterine cancers	0	1.92	0.0	0.0	191.9
Cancer of cervix uteri	0	1.08	0.0	0.0	343.0
Cancer of other female genital organs	4	2.10	190.9	52.0	488.9
Cancer of prostate	74	84.44	87.6	68.8	110.0
Cancer of testes and other male genital organs	1	2.56	39.0	1.0	217.4
Cancer of kidney	16	17.09	93.6	53.5	152.1
Cancer of bladder and other urinary organs	14	23.65	59.2*	32.4	99.3
Malignant melanoma of skin	11	8.16	134.8	67.3	241.2
Cancer of eye	2	0.51	389.3	47.1	1,406.2
Cancer of central nervous system	17	16.53	102.9	59.9	164.7
Cancer of thyroid and other endocrine glands	0	2.28	0.0	0.0	161.6
Cancer of bone	1	2.63	38.0	0.9	211.5
Cancer of all lymphatic, hemopoietic tissue	83	69.49	119.4	95.1	148.1
Lymphosarcoma and reticulosarcoma	9	9.74	92.4	42.3	175.5
Hodgkin's disease	3	5.14	58.4	12.0	170.6
Leukemia and aleukemia	39	28.07	138.9	98.8	189.9
Cancer of all other lymphopoietic tissue	32	26.56	120.5	82.4	170.1
All other malignant neoplasms	69	57.41	120.2	93.5	152.1
Benign neoplasms	8	7.29	109.7	47.4	216.2
Diabetes mellitus	44	52.99	83.0	60.3	111.5
Cerebrovascular disease	234	238.07	98.3	86.1	111.7
All heart disease	1,199	1,239.43	96.7	91.3	102.4
Rheumatic heart disease	15	16.42	91.4	51.1	150.7
Ischemic heart disease	976	1,072.17	91.0**	85.4	96.9
Chronic endocardial disease; other myocardial insufficiency	12	41.42	29.0**	15.0	50.6
Hypertension with heart disease	34	29.73	114.4	79.2	159.8
All other heart disease	162	155.02	104.5	89.0	121.9
Hypertension w/o heart disease	8	11.35	70.5	30.4	138.9
Non-malignant respiratory disease	155	252.09	61.5**	52.2	72.0
Influenza and pneumonia	60	103.04	58.2**	44.4	75.0
Bronchitis, emphysema, asthma	48	53.21	90.2	66.5	119.6
Bronchitis	3	8.77	34.2*	7.1	99.9
Emphysema	42	40.67	103.3	74.4	139.6
Asthma	3	3.85	78.0	16.1	227.8
Other non-malignant respiratory disease	47	100.71	46.7**	34.3	62.1
Ulcer of stomach and duodenum	12	13.79	87.0	45.0	152.0
Cirrhosis of liver	25	52.94	47.2**	30.6	69.7
Nephritis and nephrosis	16	18.40	86.9	49.7	141.2
All external causes of death	151	192.39	78.5**	66.5	92.1
Accidents	98	119.91	81.7*	66.3	99.6
Motor vehicle accidents	40	50.33	79.5	56.8	108.2
All other accidents	58	69.93	82.9	63.0	107.2
Suicides	38	41.01	92.7	65.6	127.2
Homicides and other external causes	15	27.98	53.6*	30.0	88.4

[a] n = 7543; person-years = 208,627; OBS, observed; EXP, expected; SMR, standardized mortality ratio.
* Significant at 5% level.
** Significant at 1% level.

95% CI, 30.6 to 69.7), and accidents (SMR, 81.7; 95% CI, 66.3 to 99.6).

Stratified analyses for male and female employees are presented in Tables 3 and 4, respectively. Because male employees represented approximately 90% of the entire cohort, their mortality experience was quite similar to that of the entire cohort. In particular, no significant increase in mortality from any cause of death was detected in male employees (Table 3). Among female employees, only 86 deaths were reported (Table 4). As such, for most causes of death, the number of deaths was small. Similar to their male counterparts, the female employees experienced a significant mortality deficit from ischemic heart disease (SMR, 56.0; 95% CI, 29.8 to 95.8). There was one death from cancer of the eye, compared with 0.02 expected. Although the corresponding SMR of 4811.3 was statistically significant, little interpretation can be attached to the finding because the SMR was based on only one death.

Table 5 shows cause-specific mortality of male employees by length of employment at the refinery. Two specific causes of death showed statistically significant trends. For cancer of the biliary passage and liver, there was a downward trend ($\chi^2_{trend} = 6.97, P < 0.01$). For male employees with less than 10 years of employment, the SMR was more than twofold, whereas among those with more than 30 years of service the SMR was significantly low (22.8). For cancer of the prostate, there was a significant upward trend ($\chi^2_{trend} = 4.10, P<0.05$). It should be pointed out that the upward trend was due primarily to deficits among employees with less than 30 years of service and that no increase was observed even among those with more than 30 years of service (SMR, 102.2). No trend was observed for any other causes of death among male employees. No analysis by duration of employment was performed for female employees, because the number of deaths was small.

Similarly, separate analyses were performed for white and non-white male employees. The results were similar to those for male employees in the total cohort; therefore, those separate results will not be presented in this article.

Long latent periods (decades) are usually required for chronic diseases to develop. In many instances, it would be more appropriate to examine mortality experience only after a certain lag period has elapsed. Table 6 shows the mortality analysis by interval since hire (latency) for male employees. No statistically significant increase in cause-specific mortality was found for any latency interval. In particular, among the 2859 employees whose latency was 40 years or longer, SMRs for both overall mortality and overall cancer were slightly lower than expected (93.1 and 90.6, respectively). In the same group, several causes of death showed statistically significant mortality deficits, including cancer of the digestive system, ischemic heart disease, non-malignant respiratory disease, cirrhosis of the liver, and accidents.

Workers were classified into broad categories of jobs (at least 6 months in the category). Separate mortality analyses were conducted for maintenance and process workers. Table 7 shows the cause-specific mortality of male maintenance employees by length of employment in maintenance jobs. No significant increase was detected for any cause of death for any length of service in the maintenance category. For leukemia, although there was a slight increase by length of service, the trend was not significant ($\chi^2_{trend} = 0.42, P > 0.05$). No upward trend was reported for any cause of death among male maintenance workers.

A similar analysis by length of service was performed for male process employees (Table 8). Although no significant increase was reported for any cause of death for any length of service in the process category, significant upward trends were detected for several causes of death. For leukemia, deficits were observed for those with less than 30 years of service, but a non-significant twofold risk was reported for the group with 30+ years of service. The upward trend for leukemia was statistically significant ($\chi^2_{trend} = 4.01, P < 0.05$). Significant upward trends were reported for all heart diseases ($\chi^2_{trend} = 8.37, P < 0.01$), influenza and pneumonia ($\chi^2_{trend} = 6.37, P < 0.05$), and suicide ($\chi^2_{trend} = 10.20, P < 0.01$). It should be noted that for these three disease categories, the trends were due primarily to significant deficits in the groups with shorter length of service in the process category and that there was no significant increase, even in the longest service group.

The specific categories of lymphatic and hemopoietic cancers used in the OCMAP program are based on the statistical classifications compiled by NCHS and do not permit a specific analysis for major cell-type specific leukemias, NHL, or MM, which are more appropriate classifications from the biological point of view.[11–13] Therefore, analyses for these specific subcategories of lymphatic and hemopoietic cancers among male employees were performed separately. Female cohort members were not included in these analyses because they contributed fewer than one expected death to each of these subcategories. Table 9 shows that there were 12 deaths from acute myeloid leukemia (AML) observed among male employees, compared with 8.15 expected (SMR, 147.2; 95% CI, 76.1 to 257.2). Five deaths from chronic myeloid leukemia were observed, which was approximately one more than the 3.81 expected (SMR, 131.4; 95% CI, 42.6 to 306.6). Non-significant deficits were observed for both acute lymphoid leukemia and chronic lymphoid leukemia. For both MM and NHL, the observed mortality was similar to that expected, the SMRs being 96.3 and 97.2, respectively. Table 9 also presents analysis by job

TABLE 3
Cause-Specific Mortality of Male Employees at the Beaumont Refinery[a]

Cause of Death	OBS	EXP	SMR	95% Confidence Limits	
				Lower	Upper
All causes of death	2,934	3,060.92	95.9*	92.4	99.4
All malignant neoplasms	641	755.89	84.8**	78.4	91.6
Cancer of buccal cavity and pharynx	5	19.76	25.3**	8.2	59.1
Cancer of digestive organs and peritoneum	151	206.17	73.2**	62.0	85.9
Cancer of esophagus	12	21.29	56.4*	29.1	98.5
Cancer of stomach	33	39.96	82.6	56.8	116.0
Cancer of large intestine	47	67.67	69.5*	51.0	92.4
Cancer of rectum	6	19.09	31.4**	11.5	68.4
Cancer of biliary passages and liver	7	14.83	47.2*	19.0	97.2
Cancer of pancreas	40	38.86	102.9	73.5	140.2
Cancer of all other digestive organs	6	7.79	77.0	28.3	167.6
Cancer of respiratory system	201	248.76	80.8**	70.0	92.8
Cancer of larynx	3	10.13	29.6*	6.1	86.6
Cancer of bronchus, trachea, lung	195	235.71	82.7**	71.5	95.2
Cancer of all other respiratory	3	2.81	106.7	22.0	311.9
Cancer of breast	3	1.03	291.0	60.0	850.3
Cancer of prostate	74	84.44	87.6	68.8	110.0
Cancer of testes and other male genital organs	1	2.56	39.0	1.0	217.4
Cancer of kidney	16	16.61	96.3	55.0	156.4
Cancer of bladder and other urinary organs	14	23.32	60.0	32.8	100.7
Malignant melanoma of skin	11	7.79	141.2	70.5	252.6
Cancer of eye	1	0.49	202.8	5.1	1,130.2
Cancer of central nervous system	16	15.74	101.7	58.1	165.1
Cancer of thyroid and other endocrine glands	0	2.16	0.0	0.0	171.0
Cancer of bone	1	2.56	39.1	1.0	217.9
Cancer of all lymphatic, hemopoietic tissue	79	66.88	118.1	93.5	147.2
Lymphosarcoma and reticulosarcoma	8	9.42	84.9	36.7	167.3
Hodgkin's disease	3	4.95	60.5	12.5	176.9
Leukemia and aleukemia	37	27.10	136.5	96.1	188.2
Cancer of all other lymphopoietic tissue	31	25.41	122.0	82.9	173.1
All other malignant neoplasms	68	55.22	123.1	95.6	156.1
Benign neoplasms	8	6.94	115.3	49.8	227.1
Diabetes mellitus	44	50.51	87.1	63.3	116.9
Cerebrovascular disease	228	230.60	98.9	86.5	112.6
All heart disease	1,182	1,210.28	97.7	92.2	103.4
Rheumatic heart disease	15	15.34	97.8	54.7	161.3
Ischemic heart disease	963	1,048.96	91.8**	86.1	97.8
Chronic endocardial disease; other myocardial insufficiency	11	39.88	27.6**	13.8	49.4
Hypertension with heart disease	34	28.76	118.2	81.9	165.2
All other heart disease	159	150.16	105.9	90.1	123.7
Hypertension w/o heart disease	7	11.04	63.4	25.5	130.6
Non-malignant respiratory disease	154	245.64	62.7**	53.2	73.4
Influenza and pneumonia	59	100.48	58.7**	44.7	75.7
Bronchitis, emphysema, asthma	48	52.05	92.2	68.0	122.3
Bronchitis	3	8.59	34.9	7.2	102.1
Emphysema	42	39.97	105.1	75.7	142.0
Asthma	3	3.62	82.9	17.1	242.4
Other non-malignant respiratory disease	47	97.82	48.0**	35.3	63.9
Ulcer of stomach and duodenum	12	13.51	88.8	45.9	155.2
Cirrhosis of liver	25	51.18	48.9**	31.6	72.1
Nephritis and nephrosis	15	17.90	83.8	46.9	138.2
All external causes of death	149	187.28	79.6**	67.3	93.4
Accidents	98	116.74	83.9	68.2	102.3
Motor vehicle accidents	40	48.76	82.0	58.6	111.7
All other accidents	58	68.32	84.9	64.5	109.7
Suicides	37	39.82	92.9	65.4	128.1
Homicides and other external causes	14	27.31	51.3**	28.0	86.0

[a] n = 6832; person-years = 192,040. For definition of abbreviations, see Table 2.
* Significant at 5% level.
** Significant at 1% level.

TABLE 4
Cause-Specific Mortality of Female Employees at the Beaumont Refinery[a]

Cause of Death	OBS	EXP	SMR	95% Confidence Limits	
				Lower	Upper
All causes of death	86	94.55	91.0	72.8	112.3
All malignant neoplasms	33	30.12	109.6	75.4	153.9
Cancer of buccal cavity and pharynx	0	0.37	0.0	0.0	993.2
Cancer of digestive organs and peritoneum	6	6.43	93.4	34.3	203.2
Cancer of esophagus	0	0.26	0.0	0.0	1,398.8
Cancer of stomach	0	0.72	0.0	0.0	511.6
Cancer of large intestine	5	2.82	177.0	57.5	413.1
Cancer of rectum	0	0.54	0.0	0.0	687.0
Cancer of biliary passages and liver	1	0.61	164.1	4.1	914.6
Cancer of pancreas	0	1.36	0.0	0.0	270.4
Cancer of all other digestive organs	0	0.23	0.0	0.0	1,628.3
Cancer of respiratory system	6	5.71	105.0	38.6	228.6
Cancer of larynx	0	0.10	0.0	0.0	3,726.7
Cancer of bronchus, trachea, lung	6	5.54	108.2	39.7	235.6
Cancer of all other respiratory	0	0.07	0.0	0.0	5,397.6
Cancer of breast	10	6.47	154.6	74.1	284.4
All uterine cancers	0	1.92	0.0	0.0	191.9
Cancer of cervix uteri	0	1.08	0.0	0.0	343.0
Cancer of other female genital organs	4	2.10	190.9	52.0	488.9
Cancer of kidney	0	0.47	0.0	0.0	778.1
Cancer of bladder and other urinary organs	0	0.33	0.0	0.0	1,124.6
Malignant melanoma of skin	0	0.37	0.0	0.0	998.0
Cancer of eye	1	0.02	4,811.3*	120.3	26,808.4
Cancer of central nervous system	1	0.79	127.0	3.2	707.9
Cancer of thyroid and other endocrine glands	0	0.13	0.0	0.0	2,920.6
Cancer of bone	0	0.08	0.0	0.0	4,757.1
Cancer of all lymphatic, hemopoietic tissue	4	2.61	153.4	41.8	392.8
Lymphosarcoma and reticulosarcoma	1	0.31	321.2	8.0	1,790.0
Hodgkin's disease	0	0.18	0.0	0.0	2,017.4
Leukemia and aleukemia	2	0.97	206.2	25.0	745.0
Cancer of all other lymphopoietic tissue	1	1.14	87.4	2.2	487.2
All other malignant neoplasms	1	2.19	45.6	1.1	254.3
Benign neoplasms	0	0.35	0.0	0.0	1,051.9
Diabetes mellitus	0	2.48	0.0	0.0	148.6
Cerebrovascular disease	6	7.47	80.3	29.5	174.8
All heart disease	17	29.15	58.3*	34.0	93.4
Rheumatic heart disease	0	1.08	0.0	0.0	342.6
Ischemic heart disease	13	23.20	56.0*	29.8	95.8
Chronic endocardial disease; other myocardial insufficiency	1	1.54	64.9	1.6	361.6
Hypertension with heart disease	0	0.96	0.0	0.0	382.7
All other heart disease	3	4.86	61.8	12.7	180.5
Hypertension w/o heart disease	1	0.31	321.5	8.0	1,791.6
Non-malignant respiratory disease	1	6.46	15.5*	0.4	86.3
Influenza and pneumonia	1	2.55	39.2	1.0	218.4
Bronchitis, emphysema, asthma	0	1.16	0.0	0.0	317.7
Bronchitis	0	0.19	0.0	0.0	1,976.7
Emphysema	0	0.70	0.0	0.0	526.5
Asthma	0	0.23	0.0	0.0	1,595.4
Other non-malignant respiratory disease	0	2.88	0.0	0.0	127.9
Ulcer of stomach and duodenum	0	0.28	0.0	0.0	1,302.5
Cirrhosis of liver	0	1.76	0.0	0.0	209.0
Nephritis and nephrosis	1	0.50	199.7	5.0	1,112.8
All external causes of death	2	5.10	39.2	4.7	141.6
Accidents	0	3.17	0.0	0.0	116.2
Motor vehicle accidents	0	1.58	0.0	0.0	234.0
All other accidents	0	1.61	0.0	0.0	228.9
Suicides	1	1.19	84.1	2.1	468.3
Homicides and other external causes	1	0.68	147.9	3.7	823.9

[a] n = 711; person-years = 16,587. For definition of abbreviations, see Table 2.
* Significant at 5% level.

TABLE 5
Cause-Specific Mortality of Male Employees at the Beaumont Refinery by Length of Employment[a]

Cause of Death	<10 Years[b] OBS	<10 Years[b] SMR	10–29 Years[c] OBS	10–29 Years[c] SMR	30+ Years[d] OBS	30+ Years[d] SMR
All causes	384	103.6	942	101.7	1,608	91.2**
All malignant neoplasms	82	88.5	194	84.4*	365	84.3**
Cancer of buccal cavity and pharynx	0	0.0	2	29.3	3	28.7*
Cancer of digestive organs and peritoneum	28	122.5	39	60.3**	84	70.8**
Cancer of esophagus	1	42.2	4	60.3	7	57.0
Cancer of stomach	6	156.6	10	74.0	17	75.2
Cancer of large intestine	8	102.4	9	45.0**	30	75.3
Cancer of rectum	1	48.2	1	15.8*	4	37.4*
Cancer of biliary passages and liver	4	217.7	1	23.6	2	22.8*
Cancer of pancreas	7	155.6	13	108.4	20	89.4
Cancer of all other digestive organs	1	118.0	1	35.4	4	97.2
Cancer of respiratory system	23	71.0	71	96.0	107	75.1**
Cancer of larynx	0	0.0	1	30.8	2	35.2
Cancer of bronchus, trachea, and lung	22	71.5	69	99.0	104	76.9**
Cancer of breast	1	824.9	0	0.0	2	351.7
Cancer of prostate	3	45.5	14	63.5	57	102.2
Cancer of kidney	4	173.9	5	94.3	7	77.7
Cancer of bladder and other urinary organs	0	0.0	6	86.9	8	56.5
Malignant melanoma of skin	2	122.7	4	146.9	5	145.4
Cancer of central nervous system	3	97.4	5	86.5	8	116.3
Cancer of lymphatic and hemopoietic tissues	11	109.7	29	135.6	39	110.0
Lymphosarcoma and reticulosarcoma	0	0.0	5	140.9	3	66.6
Hodgkin's disease	0	0.0	2	98.8	1	59.2
Leukemia	6	152.1	12	140.3	19	130.1
Cancer of other lymphopoietic tissue	5	143.7	10	137.6	16	109.1
Benign neoplasms	0	0.0	3	136.8	5	130.6
Diabetes mellitus	5	85.8	13	88.7	26	86.6
Cerebrovascular disease	24	131.5	71	106.3	133	91.4
All heart disease	131	102.3	367	101.3	684	95.0
Ischemic heart disease	103	92.8	311	98.5	549	88.2**
Non-malignant respiratory disease	14	55.7*	51	74.0*	89	58.7**
Influenza and pneumonia	4	44.1	16	54.2**	39	63.0**
Bronchitis, emphysema, and asthma	4	77.7	19	123.3	25	79.4
Other non-malignant respiratory disease	6	52.6	16	63.3	25	40.9**
Cirrhosis of liver	10	108.2	8	39.7**	7	32.1**
All external causes of death	39	74.5	64	88.6	46	73.3*
Accidents	28	93.0	42	95.8	28	65.4*
Motor vehicle accidents	15	96.9	13	69.8	12	81.9
All other accidents	13	88.5	29	114.6	16	56.5*
Suicides	7	63.1	14	90.6	16	120.5
Homicides and other external causes	4	38.1*	8	70.9	2	36.2

[a] OBS, observed; SMR, standardized mortality ratio.
[b] n = 5199; person-years = 63,080.
[c] n = 5317; person-years = 79,609.
[d] n = 2542; person-years = 49,351.
* Significant at the 5% level.
** Significant at the 1% level.

category. The non-significant mortality increase in AML for the overall cohort appeared to have occurred among maintenance workers (SMR, 185.5; 95% CI, 80.1 to 365.6).

Table 10 shows the mortality from lymphohemopoietic cancers of male employees by length of employment and by job category (maintenance and process). There was no upward trend for any of the specific categories of lymphohemopoietic cancer. For AML, the SMR for male employees with 10 to 29 years of employment was statistically significant (SMR, 276.8; 95% CI, 111.3 to 570.4). The excess appeared to have occurred among employees with 10 to 29 years of service in maintenance jobs (4 observed vs 1.75 expected deaths; SMR, 228.7; 95% CI, 62.3 to 585.6). However, no upward trend was detected for AML among maintenance workers. No significant increase or upward trend was found in process workers. Analysis by time since first employment is presented

TABLE 6

Cause-Specific Mortality of Male Employees at the Beaumont Refinery by Time Since First Employment[a]

Cause of Death	<20 Years[b]		20–39 Years[c]		40+ Years[d]	
	OBS	SMR	OBS	SMR	OBS	SMR
All causes	265	96.0	1,055	100.4	1,614	93.1**
All malignant neoplasms	43	63.6**	249	82.1**	349	90.6
Cancer of buccal cavity and pharynx	0	0.0	2	20.5**	3	39.4
Cancer of digestive organs and peritoneum	16	86.7	59	68.7**	76	74.6**
Cancer of esophagus	1	52.1	5	50.7	6	63.1
Cancer of stomach	6	142.1	12	66.4	15	84.9
Cancer of large intestine	2	40.2	12	47.5**	33	88.1
Cancer of rectum	1	51.4	2	23.9*	3	34.2*
Cancer of biliary passages and liver	3	261.6	2	36.5	2	24.4*
Cancer of pancreas	2	59.9	21	128.8	17	88.4
Cancer of all other digestive organs	1	91.3*	5	134.4	0	0.0
Cancer of respiratory system	10	49.0*	83	77.1*	108	89.4
Cancer of larynx	0	0.0	1	21.0	2	45.5
Cancer of bronchus, trachea, and lung	8	42.1**	82	80.8	105	91.2
Cancer of breast	0	0.0	1	231.1	2	410.3
Cancer of prostate	2	89.1	24	108.6	48	79.9
Cancer of kidney	0	0.0	7	96.9	9	117.4
Cancer of bladder and other urinary organs	0	0.0	6	72.6	8	58.3
Malignant melanoma of skin	3	192.9	4	123.8	4	133.1
Cancer of central nervous system	2	61.3	9	121.6	5	98.6
Cancer of lymphatic and hemopoietic tissues	8	87.9	30	117.7	41	126.9
Lymphosarcoma and reticulosarcoma	1	58.1	3	66.5	4	125.3
Hodgkin's disease	1	56.5	2	95.6	0	0.0
Leukemia	2	56.8	14	140.7	21	154.1
Cancer of other lymphopoietic tissue	4	190.3	11	123.2	16	111.2
Benign neoplasms	0	0.0	2	79.0	6	163.8
Diabetes mellitus	4	100.3	14	83.0	26	87.6
Cerebrovascular disease	13	114.6	74	108.6	141	93.3
All heart disease	82	103.5	435	102.5	665	94.1
Ischemic heart disease	70	104.3	370	98.7	523	86.2**
Non-malignant respiratory disease	4	33.3*	51	73.9*	99	60.2**
Influenza and pneumonia	2	36.1	10	39.5**	47	67.5**
Bronchitis, emphysema, and asthma	2	63.5	22	118.6	24	79.1
Other non-malignant respiratory disease	0	0.0	19	72.8	28	41.1**
Cirrhosis of liver	6	61.7	12	45.1**	7	47.2*
All external causes of death	60	87.1	52	77.1	37	72.6
Accidents	42	108.5	35	84.1	21	57.7**
Motor vehicle accidents	17	83.6	12	69.8	11	97.9
All other accidents	25	135.3	23	93.9	10	39.4**
Suicides	12	87.6	10	64.7	15	140.9
Homicides and other external causes	6	39.7*	7	78.1	1	30.8

[a] For definition of abbreviations, see Table 5.
[b] n = 5937; person-years = 88,098.
[c] n = 5347; person-years = 73,377.
[d] n = 2859; person-years = 30,565.
* Significant at the 5% level.
** Significant at the 1% level.

in Table 11. No significant increase was detected for any categories of lymphohemopoietic cancers for any latency group.

Analysis of mortality from lymphatic and hemopoietic cancers by year of first employment has been found to be informative in other studies of petroleum workers. In 1947, the recommended standard for benzene was reduced from 100 ppm to 50 ppm, which was further reduced to 35 ppm in 1948. In general, benzene exposure levels in the petroleum industry after 1948 to 1950 were much lower than in previous years. Thus, a stratified analysis by date of first exposure (<1950 vs ≥1950) would be informative. Results for such a stratified analysis are presented in Table 12. No significant increase was observed in any category of lymphohemopoietic cancers regardless of time of hire. However,

TABLE 7
Cause-Specific Mortality of Male Maintenance Employees at the Beaumont Refinery by Length of Maintenance Jobs[a]

Cause of Death	<10 Years[b]		10–29 Years[c]		30+ Years[d]		Total[e]	
	OBS	SMR	OBS	SMR	OBS	SMR	OBS	SMR
All causes	342	75.1**	593	82.2**	441	83.3**	1,376	80.6**
All malignant neoplasms	80	71.4**	120	68.3**	110	86.0	310	74.6**
Cancer of buccal cavity and pharynx	1	32.9	0	0.0*	2	67.2	3	27.6*
Cancer of digestive organs and peritoneum	16	56.3*	25	50.4**	29	83.1	70	62.0**
Cancer of esophagus	1	31.0	3	52.8	3	80.5	7	55.4
Cancer of stomach	5	102.1	4	38.2*	2	30.1	11	49.9*
Cancer of large intestine	4	42.2	9	59.4	9	76.9	22	60.5*
Cancer of rectum	1	40.8	1	22.5	2	66.2	4	40.3
Cancer of biliary passages and liver	0	0.0	1	28.9	1	37.6	2	23.7*
Cancer of pancreas	4	72.2	5	54.6	10	152.1	19	89.3
Cancer of all other digestive organs	1	101.7	2	102.1	2	171.9	5	121.8
Cancer of respiratory system	25	63.7*	42	74.3	33	78.9	100	72.7**
Cancer of larynx	0	0.0	0	0.0	0	0.0	0	0.0**
Cancer of bronchus, trachea, and lung	25	67.1*	42	78.7	32	80.5	99	75.9**
Cancer of breast	1	676.1	0	0.0	0	0.0	1	176.1
Cancer of prostate	7	71.8	19	90.3	17	96.9	43	89.0
Cancer of kidney	1	37.9	4	109.8	3	116.8	8	90.4
Cancer of bladder and other urinary organs	1	35.0	1	19.2	2	48.5	4	32.8*
Malignant melanoma of skin	1	62.8	1	66.2	1	107.1	3	74.3
Cancer of central nervous system	2	65.0	3	90.7	1	53.6	6	72.7
Cancer of lymphatic and hemopoietic tissues	11	100.6	13	88.5	13	126.3	37	103.0
Lymphosarcoma and reticulosarcoma	0	0.0	0	0.0	1	80.9	1	20.8
Hodgkin's disease	1	94.0	0	0.0	0	0.0	1	38.8
Leukemia	5	117.1	7	119.4	7	165.9	19	132.4
Cancer of other lymphopoietic tissue	5	119.4	6	107.1	5	114.0	16	112.9
Benign neoplasms	1	90.8	2	122.8	2	174.2	5	128.9
Diabetes mellitus	2	26.5*	14	114.8	6	65.1	22	76.0
Cerebrovascular disease	22	84.0	57	96.8	29	65.3*	108	83.4
All heart disease	118	72.3**	228	80.4**	198	92.4	544	82.3**
Ischemic heart disease	99	70.9**	191	79.1**	154	84.1*	444	78.7**
Non-malignant respiratory disease	21	63.8*	45	81.1	21	45.5**	87	64.7**
Influenza and pneumonia	6	48.1	15	61.4	8	41.8**	29	51.7**
Bronchitis, emphysema, and asthma	2	30.0	16	138.5	6	65.0	24	87.5
Other non-malignant respiratory disease	13	90.0	14	68.0	7	37.4**	34	63.3**
Cirrhosis of liver	3	28.7*	1	8.0**	1	16.5*	5	17.2**
All external causes of death	24	48.9**	23	55.0**	10	55.2	57	52.3**
Accidents	15	52.9**	16	60.4*	7	55.9	38	56.4**
Motor vehicle accidents	4	29.4**	6	58.1	3	71.5	13	46.2**
All other accidents	11	74.2	10	61.7	4	47.8	25	63.4*
Suicides	6	59.1	5	63.9	2	55.5	13	60.2
Homicides and other external causes	3	30.1*	2	30.7	1	59.6	6	33.0**

[a] For definition of abbreviations, see Table 5.
[b] n = 2996; person-years = 53,288.
[c] n = 2103; person-years = 38,565.
[d] n = 680; person-years = 13,205.
[e] n = 3459; person-years = 105,058.
* Significant at 5% level.
** Significant at 1% level.

the AML SMR for those hired before 1950 (SMR, 166.7) appeared to be higher than that for workers hired in 1950 or later (SMR, 64.4).

Because of the previous use of asbestos at the refinery, mortality from asbestos-related diseases (asbestosis, lung cancer, and mesothelioma) among cohort members was examined. Although the OCMAP program provided an analysis for lung cancer, it did not provide a separate analysis for asbestosis or malignant mesothelioma of the peritoneum or pleura. Analyses for asbestosis (pulmonary fibrosis) and malignant mesothelioma of the peritoneum or pleura were performed separately. The term asbestosis refers to pulmonary fibrosis caused by exposure to asbestos, or pulmonary fibrosis in persons with a documented asbestos exposure history. The ICD-8 code for asbestosis is 515.2

TABLE 8
Cause-Specific Mortality of Male Process Employees at the Beaumont Refinery by Length of Process Jobs[a]

Cause of Death	<10 Years[b]		10–29 Years[c]		30+ Years[d]		Total[e]	
	OBS	SMR	OBS	SMR	OBS	SMR	OBS	SMR
All causes	260	64.4**	489	85.2**	308	93.6	1,057	80.9**
All malignant neoplasms	57	59.6**	103	73.0**	66	91.2	226	73.1**
Cancer of buccal cavity and pharynx	0	0.0	2	54.0	0	0.0	2	24.7*
Cancer of digestive organs and peritoneum	17	67.9	14	36.1**	15	74.7	46	54.8**
Cancer of esophagus	1	30.8	3	72.9	0	0.0	4	44.5
Cancer of stomach	2	41.8	3	39.6	4	112.2	9	56.5
Cancer of large intestine	6	77.2	3	23.8**	8	110.1	17	61.5*
Cancer of rectum	1	49.9	1	28.1	0	0.0	2	26.3*
Cancer of biliary passages and liver	1	46.7	0	0.0	0	0.0	1	16.0*
Cancer of pancreas	6	127.4	4	54.6	2	52.5	12	75.7
Cancer of all other digestive organs	0	0.0	0	0.0	1	142.7	1	33.4
Cancer of respiratory system	14	43.5**	41	88.0	17	74.4	72	70.9**
Cancer of larynx	0	0.0	0	0.0	2	216.3	2	48.0
Cancer of bronchus, trachea, and lung	14	45.9**	41	92.9	15	69.2	70	72.7**
Cancer of breast	0	0.0	0	0.0	1	1,046.7	1	237.4
Cancer of prostate	6	61.1	12	72.2	9	96.9	27	75.5
Cancer of kidney	1	48.1	3	99.0	0	0.0	4	60.0
Cancer of bladder and other urinary organs	2	88.3	4	91.6	1	35.2	7	73.9
Malignant melanoma of skin	1	81.0	1	79.0	1	174.0	3	97.6
Cancer of central nervous system	4	168.8	1	37.0	3	260.6	8	128.6
Cancer of lymphatic and hemopoietic tissues	9	101.2	9	75.3	11	174.1	29	106.8
Lymphosarcoma and reticulosarcoma	0	0.0	0	0.0	1	104.3	1	26.9
Hodgkin's disease	0	0.0	0	0.0	1	303.7	1	51.6
Leukemia	2	58.4	3	62.2	6	219.0	11	100.1
Cancer of other lymphopoietic tissue	7	193.5	6	130.1	3	131.0	16	152.1
Benign neoplasms	1	106.5	2	154.8	0	0.0	3	102.3
Diabetes mellitus	7	99.0	8	83.4	5	98.6	20	92.0
Cerebrovascular disease	19	74.0	44	96.3	23	80.8	86	86.2
All heart disease	86	63.1**	192	82.8**	135	95.0	413	80.9**
Ischemic heart disease	64	57.5**	163	81.3**	106	83.4	333	75.9**
Non-malignant respiratory disease	14	51.0**	32	68.6*	24	80.0	70	67.2**
Influenza and pneumonia	4	34.2*	13	66.7	15	121.1	32	73.4
Bronchitis, emphysema, and asthma	4	80.4	7	71.1	5	71.1	16	73.2
Other non-malignant respiratory disease	6	52.7	12	65.9	4	35.9*	22	54.0**
Cirrhosis of liver	4	43.7	2	22.1*	2	57.3	8	36.9**
All external causes of death	22	46.2**	19	69.9	13	121.7	54	63.2**
Accidents	15	55.2*	15	84.2	6	80.4	36	68.6*
Motor vehicle accidents	3	23.3**	6	89.4	0	0.0	9	40.8**
All other accidents	12	83.4	9	80.7	6	119.9	27	88.4
Suicides	3	33.1*	4	70.4	6	245.8	13	75.6
Homicides and other external causes	4	36.8*	0	0.0	1	184.0	5	34.6**

[a] For definition of abbreviations, see Table 5.
[b] n = 2546; person-years = 46,530.
[c] n = 1248; person-years = 25,821.
[d] n = 366; person-years = 7559.
[e] n = 2927; person-years = 79,911.
* Significant at 5% level.
** Significant at 1% level.

and therefore is part of the broad category "other non-malignant respiratory disease" (ICD-8 460 to 519) in the OCMAP analysis. In the Beaumont cohort, asbestosis was coded as the underlying cause of death in three deaths. However, because certifying physicians might not be aware of the decedents' asbestos exposure (if any), such deaths could have been coded simply as pulmonary fibrosis or pneumoconiosis. Therefore, the category "pulmonary fibrosis" was analyzed. For pulmonary fibrosis (ICD-8 515 to 517), there were eight observed deaths among all male cohort members, compared with 15.68 expected. The corresponding SMR for pulmonary fibrosis among male employees was 51.0 (95% CI, 22.0 to 100.4). All eight male employees who died from pulmonary fibrosis had worked in maintenance jobs (compared with

TABLE 9
Mortality From Lymphohemopoietic Cancers of Male Employees at the Beaumont Refinery*

Cause of Death	OBS	EXP	SMR	95% CI
Total cohort				
Acute lymphoid leukemia	0	1.23	0.0	0.0–299.2
Chronic lymphoid leukemia	1	5.39	18.5	0.5–103.3
Acute myeloid leukemia	12	8.15	147.2	76.1–257.2
Chronic myeloid leukemia	5	3.81	131.4	42.6–306.6
Multiple myeloma	14	14.54	96.3	52.7–161.6
Non-Hodgkin's lymphoma	26	26.75	97.2	63.5–142.4
Maintenance				
Acute lymphoid leukemia	0	0.64	0.0	0.0–577.6
Chronic lymphoid leukemia	1	2.89	34.6	0.9–192.8
Acute myeloid leukemia	8	4.31	185.5	80.1–365.6
Chronic myeloid leukemia	3	2.05	146.4	30.2–427.8
Multiple myeloma	5	8.36	59.8	19.4–139.5
Non-Hodgkin's lymphoma	11	14.08	78.1	39.0–139.8
Process				
Acute lymphoid leukemia	0	0.50	0.0	0.0–731.2
Chronic lymphoid leukemia	0	2.20	0.0	0.0–167.3
Acute myeloid leukemia	4	3.28	122.1	33.3–312.7
Chronic myeloid leukemia	0	1.57	0.0	0.0–235.4
Multiple myeloma	6	6.03	99.4	36.5–216.4
Non-Hodgkin's lymphoma	10	10.75	93.0	44.6–171.1

* OBS, observed; EXP, expected; SMR, standardized mortality ratio; CI, confidence interval.

TABLE 10
Mortality From Lymphohemopoietic Cancers of Male Employees at the Beaumont Refinery by Length of Employment[a]

	<10 Years			10–29 Years			30+ Years		
Cause of Death	OBS	SMR	95% CI	OBS	SMR	95% CI	OBS	SMR	95% CI
Total cohort									
Acute lymphoid leukemia	0	0.0	0.0–1402.6	0	0.0	0.0–902.8	0	0.0	0.0–657.2
Chronic lymphoid leukemia	0	0.0	0.0–717.0	1	66.9	1.7–372.5	0	0.0	0.0–109.1
Acute myeloid leukemia	2	161.0	19.5–581.6	7	276.8*	111.3–570.4	3	68.5	14.1–200.2
Chronic myeloid leukemia	1	154.2	3.9–859.2	2	150.8	18.3–544.9	2	109.2	13.2–394.5
Multiple myeloma	3	210.0	43.3–613.6	4	93.8	25.6–240.1	7	79.2	31.8–163.1
Non-Hodgkin's lymphoma	2	50.5	6.1–182.4	12	136.5	70.6–238.5	12	85.7	44.3–149.7
Maintenance									
Acute lymphoid leukemia	0	0.0	0.0–1514.5	0	0.0	0.0–1567.4	0	0.0	0.0–2309.7
Chronic lymphoid leukemia	0	0.0	0.0–553.6	1	82.0	2.1–457.0	0	0.0	0.0–367.2
Acute myeloid leukemia	2	153.0	18.5–552.6	4	228.7	62.3–585.6	2	159.3	19.3–575.6
Chronic myeloid leukemia	0	0.0	0.0–543.2	2	237.3	28.7–857.2	1	189.5	4.7–1056.1
Multiple myeloma	2	103.1	12.5–372.5	0	0.0*	0.0–99.3	3	110.7	22.8–323.5
Non-Hodgkin's lymphoma	4	92.3	25.1–236.2	4	69.2	18.9–177.3	3	75.7	15.6–221.2
Process									
Acute lymphoid leukemia	0	0.0	0.0–1901.1	0	0.0	0.0–1928.6	0	0.0	0.0–3095.9
Chronic lymphoid leukemia	0	0.0	0.0–662.5	0	0.0	0.0–362.9	0	0.0	0.0–584.5
Acute myeloid leukemia	1	95.8	2.4–534.0	2	139.6	16.9–504.3	1	125.1	3.1–697.1
Chronic myeloid leukemia	0	0.0	0.0–634.6	0	0.0	0.0–565.5	0	0.0	0.0–1105.7
Multiple myeloma	1	52.6	1.3–293.3	3	106.5	22.0–311.2	2	151.9	18.4–548.7
Non-Hodgkin's lymphoma	4	115.3	31.4–295.2	3	63.7	13.2–186.3	3	116.5	24.0–340.5

[a] For definition of abbreviations, see Table 9.
* Significant at the 5% level.

8.15 expected), and three of the eight had also worked in process jobs (compared with 6.26 expected).

As stated above, lung cancer results were provided by the routine OCMAP program. The results for the overall cohort are presented in Table 2 (SMR, 83.3; 95% CI, 72.2 to 95.7). The lung cancer SMR for all male employees was 82.7 (95% CI, 71.5 to 95.2). Exposure to asbestos has been linked to malignant peritoneal and pleural mesothelioma in epidemiologic studies. Malignant peritoneal mesothelioma is part of "malignant

TABLE 11
Mortality From Lymphohemopoietic Cancers of Male Employees at the Beaumont Refinery by Time Since First Employment*

	<20 Years			20–39 Years			40+ Years		
Cause of Death	OBS	SMR	95% CI	OBS	SMR	95% CI	OBS	SMR	95% CI
Total cohort									
Acute lymphoid leukemia	0	0.0	0.0–1,241.4	0	0.0	0.0–985.3	0	0.0	0.0–657.1
Chronic lymphoid leukemia	0	0.0	0.0–1,603.3	1	56.7	1.4–315.8	0	0.0	0.0–108.6
Acute myeloid leukemia	1	94.9	2.4–528.6	5	158.8	51.5–370.5	6	152.0	55.8–330.9
Chronic myeloid leukemia	0	0.0	0.0–512.7	2	142.4	17.2–514.5	3	178.3	36.8–521.1
Multiple myeloma	2	203.0	24.6–733.3	3	53.5	11.0–156.2	9	113.4	51.8–215.2
Non-Hodgkin's lymphoma	4	112.1	30.5–287.0	12	112.9	58.3–197.2	10	79.6	38.2–146.5
Maintenance									
Acute lymphoid leukemia	0	0.0	0.0–2,109.6	0	0.0	0.0–1,724.0	0	0.0	0.0–1,476.7
Chronic lymphoid leukemia	0	0.0	0.0–2,482.0	1	92.0	2.3–512.5	0	0.0	0.0–223.0
Acute myeloid leukemia	1	158.3	4.0–882.0	3	165.5	34.1–483.6	4	214.3	58.4–548.6
Chronic myeloid leukemia	0	0.0	0.0–848.3	3	374.1	77.2–1,093.3	0	0.0	0.0–453.9
Multiple myeloma	0	0.0	0.0–576.6	1	28.7	0.7–159.7	4	94.5	25.7–241.9
Non-Hodgkin's lymphoma	2	91.7	11.1–331.2	4	66.3	18.1–169.8	5	85.2	27.7–198.9
Process									
Acute lymphoid leukemia	0	0.0	0.0–2,448.7	0	0.0	0.0–2,194.9	0	0.0	0.0–1,985.8
Chronic lymphoid leukemia	0	0.0	0.0–1,883.7	0	0.0	0.0–409.8	0	0.0	0.0–332.8
Acute myeloid leukemia	2	320.7	38.8–1,158.5	1	70.6	1.8–393.3	1	81.0	2.0–451.2
Chronic myeloid leukemia	0	0.0	0.0–913.2	0	0.0	0.0–589.4	0	0.0	0.0–686.3
Multiple myeloma	1	121.0	3.0–674.3	2	71.8	8.7–259.2	3	124.0	25.6–362.3
Non-Hodgkin's lymphoma	1	46.5	1.2–259.1	7	151.1	60.7–311.2	2	50.4	6.1–182.2

* For definition of abbreviations, see Table 9.

TABLE 12
Mortality From Lymphohemopoietic Cancers of Male Workers at the Beaumont Refinery by Year of Hire*

	Hired Before 1950				Hired 1950 or Later			
Cause of Death	OBS	EXP	SMR	95% CI	OBS	EXP	SMR	95% CI
Acute lymphoid leukemia	0	0.92	0.0	0.0–400.0	0	0.31	0.0	0.0–1187.6
Chronic lymphoid leukemia	1	4.74	21.1	0.5–117.5	0	0.65	0.0	0.0–567.4
Acute myeloid leukemia	11	6.60	166.7	83.2–298.4	1	1.55	64.4	1.6–358.8
Chronic myeloid leukemia	4	2.96	135.2	36.9–346.3	1	0.85	117.9	2.9–656.9
Multiple myeloma	12	12.59	95.3	49.3–166.5	2	1.95	102.7	12.4–370.8
Non-Hodgkin's lymphoma	22	21.40	102.8	64.4–155.7	4	5.35	74.7	20.4–191.3

* For definition of abbreviations, see Table 9.

neoplasm of the peritoneum and retroperitoneal tissue" (ICD-8 158), and malignant pleural mesothelioma is part of "malignant neoplasm of the pleura" (ICD-8 163). The most comprehensive mortality rates for malignant peritoneal and pleural mesothelioma for the United States are those compiled by the National Cancer Institute in the SEER program.[9,10] In that program, cases were selected that had the International Classification of Diseases for Oncology morphology code 905 (mesothelial neoplasms) and topography codes 158 (peritoneum) or 163 (pleura). In addition, only malignant cases were included.[10] In the present study, diagnostic information was based entirely on death certificates, and no morphologic information was available. In the previous update (1946 to 1987), one death was coded as ICD-8 163 (malignant neoplasm of the pleura) and was listed specifically as "mesothelioma of the left pleura" on the death certificate. In the present update (extended through the end of 1996), no additional death coded as either peritoneal (ICD-8 158) or pleural (ICD-8 163) cancer was found. Based on the SEER program rates, approximately 4.13 deaths from malignant mesothelioma of the pleura were expected. The corresponding SMR was 24.2 (95% CI, 0.6 to 134.4).

Discussion

In this section, we first compare some of the major results in the updated study with those previously

reported for the Beaumont cohort by Raabe et al.[3] We then discuss several specific findings in the updated study that are of particular interest in epidemiologic studies of refinery workers.

The extended enrollment and follow-up in this update on Beaumont refinery workers added 424 workers (+6.0%), 42,200 person-years (+25.4%), and 726 additional deaths (+31.6%). In the previous analysis, 32.2% of cohort members were deceased compared with 40.0% in this update. Updated results for the total cohort were consistent with earlier reports, which demonstrated a favorable overall mortality experience of the Beaumont refinery workers. Based on national rates, the updated SMR of 95.7 for all causes showed a significant deficit of 4.3%, which was less than the deficit previously observed (SMR, 82). As in the previous study, the favorable overall mortality experience of these refinery workers might be attributed to the "healthy worker effect," whereby working populations exhibit decreased overall mortality because of their initial selection into the workplace and maintenance of this healthier status through the benefits derived from employment. It is also commonly observed that the healthy worker effect generally diminishes with increasing follow-up. The reporting of a smaller overall mortality deficit in the present update is consistent with this general observation.

The earlier reports showed statistically significant deficits for a variety of non-malignant disease categories: heart diseases, non-malignant respiratory disease (specifically, pneumonia), diseases of the digestive system, diseases of the genitourinary system, and accidents. Similar significant deficits were also observed in the updated study.

The updated SMR of 85.8 (95% CI, 79.4 to 92.5) for all cancers for the total cohort was slightly lower than that previously reported (SMR, 92) and was statistically significant. For the entire cohort, significant deficits were observed for cancers of the digestive system, respiratory system, and bladder. No significant increase was reported for any cancer site. Among female employees, however, a statistically significant SMR of 4811.3 was reported for cancer of the eye. This finding was based on only one death, so little interpretation can be made.

Analysis by length of employment also indicated no work-related mortality pattern for male employees. Although there was a significant upward trend for prostate cancer, none of the SMRs was elevated. In fact, the upward trend could be attributed to significant deficits among employees with a shorter duration of service. In a recent review of epidemiologic studies of petroleum workers, Wong and Raabe[14] reported that in most studies prostate cancer SMR was below or close to 100. The summary SMR for all petroleum workers was 98 (95% CI, 94 to 103). Based on a study of workers at the Mobil (now Valero) Paulsboro refinery, Collingwood et al[15] reported a significantly elevated SMR of 144 (95% CI, 106 to 190). The SMRs were 88, 153, and 154 for <20, 20 to 29, and 30+ years of employment. However, a formal analysis by length of employment showed no significant upward trend ($\chi^2_{trend} = 0.93$, $P > 0.05$). A small, but borderline significant, mortality increase in prostate cancer was reported by Divine and Hartman[16] in the Texaco study of crude oil workers (SMR, 119; 95% CI, 100 to 141). The increase appeared to have been concentrated among short-term workers (1 to 4 years) in certain occupations: 197 (95% CI, 108 to 331) for pumpers, 145 (95% CI, 86 to 229) for maintenance, and 168 (95% CI, 113 to 239) for roustabouts. On the other hand, SMRs for the long-term workers in the same occupations were lower, and none was significant.

In terms of specific process units at refineries, Wong and Raabe[14,17] cited two small studies of employees at methyl ethyl ketone dewaxing units (at the Shell Deer Park refinery and the Chevron Port Arthur refinery) that reported an increased risk of prostate cancer mortality.[18,19] On the other hand, a third small study of methyl ethyl ketone–dewaxing employees in the United Kingdom reported no such increase.[20] A number of non-occupational risk factors for prostate cancer have been suggested by previous epidemiologic studies: dietary fat intake, hormonal stimulation, and sexual habits. None of these potential risk factors was available in the present study of employees at the Beaumont refinery or in any other studies of petroleum workers.

The issue of diagnostic sensitivity bias should also be considered. The ages of the prostate cancer patients in these cohort studies extended into the 90s. One likely explanation was that the comprehensive medical plans of long-term retired workers may have resulted in more complete diagnosis and reporting of prostate cancer among these workers as compared with workers having a shorter length of service, who are less likely to retire with medical coverage. This potential diagnostic sensitivity or reporting bias associated with length of service could help explain, at least in part, the observed trend.

In addition, chance could be a possible explanation. More than 60 causes of death were included in the routine OCMAP analyses, and a few statistically significant upward or downward trends could have resulted from chance. Indeed, a significant downward trend by length of employment was observed for liver cancer ($\chi^2_{trend} = 6.97$, $P < 0.01$), but the downward trend certainly could not be attributed to exposures at the refinery.

Because of potential differences in exposures and exposure patterns, separate analyses were performed for maintenance and process workers at the refinery. Maintenance employees in the present update included specific crafts workers such as automotive mechanics, boilermakers, blacksmiths, utility men, carpenters,

painters, electricians, pipefitters, welders, etc. It should be emphasized that the job categories used in the previous update were limited because maintenance or mechanical jobs represented a "residual" category after excluding administrative, technical (ie, engineering or laboratory), and process unit operator jobs. Specifically, service workers in process unit jobs that were not designated as operators or controlmen were considered as maintenance workers in the previous study. The job classification scheme in the present update represents a considerable improvement in that it was based on a detailed assessment and classification of all job titles or departments in the study. In the previous update,[3] significant mortality increases from several causes of death were reported among maintenance workers, including prostate cancer, leukemia, and cancer of all other lymphopoietic tissues. In the present update, no significant increase or upward trend was reported for any cause of death among male maintenance workers.

In contrast, although no significant mortality increase was detected among male process workers, significant upward trends were observed for several causes of death, including leukemia, all heart disease, influenza and pneumonia, and suicides. For male employees with more than 30 years of experience in process operations, the leukemia SMR was 219.0 (not statistically significant). The leukemia excess will be discussed further (below) in terms of specific cell types. For all heart disease and influenza and pneumonia, the upward trends were due primarily to significant deficits among employees with a shorter length of service as process workers. For these two causes of death, no increased mortality was found for the overall cohort or for any length-of-employment group. Therefore, the upward trends were not likely to be indicative of an occupational origin. For suicides, a significant deficit was found among those with less than 10 years of service as process workers (SMR, 33.1), but a non-significant increase of more than twofold (SMR, 245.8, based on six suicides) was reported for those with more than 30 years of experience in process jobs. Overall, a 25% deficit of mortality from suicide was found among process employees. There is little biological ground to argue for an association between exposures at the refinery and mortality from suicide.

As stated above, the OCMAP program does not provide analyses specific to subgroups of lymphohemopoietic cancers. No increase was reported for acute lymphoid leukemia, chronic lymphoid leukemia, MM, or NHL. For chronic myeloid leukemia, there were five deaths, compared with the 3.81 expected. For AML, there was a non-significant increase among all male employees (SMR, 147.2, based on 12 deaths). Among male employees with 10 to 29 years of employment at the refinery, mortality from AML was significantly elevated. Increased risks of AML have been reported in studies of workers exposed to high levels of benzene.[21] Unfortunately, no quantitative information on historical benzene exposure at the Beaumont refinery was available. Nevertheless, based on a consideration of the historical changes in benzene exposure levels, the year of first employment at the Beaumont refinery (<1950 and 1950+) was used as a surrogate. For AML, there was a stark contrast in risk by time of employment at the refinery; the risk for those hired before 1950 was 21/2 times that for those hired in 1950 and later. This observation was consistent with results reported in other studies of petroleum workers.[22]

Because AML mortality was elevated among maintenance workers (8 observed vs 4.31 expected deaths), the employment histories of the workers were examined. Of the eight decedents, seven had been hired before 1947. The remaining individual, who had been hired in 1974, had worked at the refinery for less than 11/2 years. This individual died from AML in 1976 at age 24. Given the extremely short time interval between exposure and death, it was highly unlikely that this AML death was related to his short employment at the refinery. Based on an analysis stratified by date of hire, the SMRs for AML were 202.9 (95% CI, 81.6 to 418.1) and 112.5 (95% CI, 2.8 to 626.7) for maintenance workers hired before 1950 and in 1950 or later, respectively. Thus, it appeared that the AML mortality excess was limited to maintenance workers who were hired before 1950.

Similar to other industrial facilities, asbestos was used at the Beaumont refinery in the past, and detailed analyses of asbestos-related diseases were performed for male employees. Although specific exposure measurements were not available, data from the industry as a whole indicate that asbestos concentrations at refineries were generally extremely low.[1] Among Beaumont refinery employees, there were three deaths with "asbestosis" recorded as the underlying cause of death. The term asbestosis refers to pulmonary fibrosis in persons with documented asbestos exposure history. Because certifying physicians might not be aware of the decedents' asbestos exposure, such deaths could have been coded simply as pulmonary fibrosis or pneumoconiosis. In terms of pulmonary fibrosis, eight deaths (including the three asbestosis cases) were reported, fewer than the 15.68 expected (SMR, 51.0; 95% CI, 22.0 to 100.4). Separate analyses by job category (maintenance and process) revealed no elevated mortality from pulmonary fibrosis.

One death in the cohort was coded as ICD-8 163 (malignant neoplasm of the pleura) and listed as "mesothelioma of the left pleura" on the death certificate, whereas 4.13 deaths were expected. In addition to the malignant pleural mesothelioma case, the word mesothelioma was mentioned on two additional death certificates.

The causes of death listed on the death certificates were "mesothelioma" and "malignant mesothelioma" (with no specific site). According to the SEER program criteria, the information provided on the death certificates was not sufficient to classify these two deaths specifically as either malignant mesothelioma of the peritoneum or malignant mesothelioma of the pleura. However, even if these two deaths were counted as malignant pleural mesothelioma, there was still no increased mortality.

In addition to the statistical analysis, records of the three asbestosis cases and the three mesothelioma cases were examined. In two of the asbestosis cases, it was stated on the death certificates that no autopsy was performed. In the same two cases, chronic obstructive pulmonary disease was a contributory cause of death. In the remaining case, no information on autopsy was provided. In all three asbestosis cases, the decedents had started working at the Beaumont refinery at or after age 30, with respective hire dates of 1943, 1947, and 1952. One had worked in maintenance jobs only, and the other two in both maintenance and process jobs. The individual who died from malignant mesothelioma of the pleura had begun working at the refinery at age 21 in 1932. He had worked in both process and administrative (supervisory) jobs. The other two workers with mesothelioma had both begun working in maintenance jobs at the refinery at age 26 in 1928 and 1947, respectively. Judging by their ages at hire at the refinery, it was likely that these individuals might have worked in asbestos-exposed jobs elsewhere. It has been reported that some refinery workers who developed mesothelioma had been exposed to asbestos at shipyards before working at refineries.[23,24] Because the Beaumont facility is located in the Gulf Coast area, it is likely that some of the employees might have worked in the shipbuilding or repairing industry. An examination of the employment records of the asbestosis and mesothelioma cases was made. The records for one mesothelioma case were no longer available, because they exceeded the record retention period. In another mesothelioma case, no employment application form was found. In general, the information (names of companies or professions) provided on employment application forms in the remaining cases was non-specific, and it was difficult to determine whether the jobs entailed asbestos exposure and, if so, to what extent. In one case of asbestosis, however, the records indicated that the decedent had served in the navy for 4 years in the late 1930s and had worked at a shipyard for 5 years in the early 1940s. Most likely this individual had been exposed to asbestos during these two time periods. It should be noted that in five of the six asbestosis or mesothelioma cases, the decedents had started working at the refinery in or before the 1940s.

In the overall cohort, lung cancer mortality was similar to that expected. Furthermore, analysis by duration of employment among male employees showed no upward trend in lung cancer risk. Thus, the data indicated no relationship between lung cancer mortality and length of employment at the Beaumont refinery for the overall cohort. A nested case-control study of lung cancer among Beaumont refinery employees was recently completed.[4] Analyses by job category and hire date were performed after adjusting for cigarette smoking. No increased risk was detected for maintenance workers. However, for process workers hired before 1940, a significant risk (odds ratio [OR], 4.11) was found. Unfortunately, it was not possible to link the excess to any historical specific exposures at the refinery. In the nested case-control study, a non-significant increase (OR, 1.34) was reported for employees with more than 35 years of occasional or routine exposure to asbestos at the refinery, and the increase appeared to have occurred among employees exposed to asbestos before 1940 at the refinery (OR, 1.89).

In this study, some potential limitations may be found, most of which are typical of a historical mortality study of industrial populations. First, although both the percentage of individuals with unknown vital status (1.7%) and the proportion of deaths with no death certificate information (1.5%) were low, it was possible (but unlikely) that some deaths from causes of interest might have been missed. We do not believe that such low percentages would have any significant impact on our results.

Second, the health end point in our study was mortality, which is a reasonable surrogate for the incidence of many cancers. Analyses were based on the underlying cause of death listed on death certificates. As such, the investigation inherited the problems associated with death certificates (diagnostic accuracy, for example). No detailed clinical information was available on the deaths in our study. However, it must be pointed out that although detailed information derived from medical records or pathology reports may be more accurate than that based on death certificates, it would be inappropriate to use such information for comparisons with national mortality rates. In our study we compared diagnoses based on death certificates with national statistics that were derived from death certificates as well. Furthermore, our analysis was adjusted for calendar time, thus at least partially controlling for changes in survival and diagnostic practices.

As in most historical cohort mortality studies, little quantitative exposure data were available during the early part of the study, and analyses by quantitative exposure indices were not possible. In the present study, we relied on duration of employment, period of first exposure, and the broad classification of jobs (process and maintenance). Although such exposure surrogates could be informative, they might lack both sensitivity and specificity.

In some sub-cohort analyses, particularly those stratified by job category and by length of employment, the numbers of death from some causes were small.

As a result, the corresponding 95% CIs were wide and the findings must be interpreted with caution.

Finally, information on lifestyle or exposures from employment elsewhere was not available, although such information would have been extremely helpful in interpreting some of the findings in the present study. From a methodologic point of view, the most appropriate approach of incorporating lifestyle risk factors and exposures from employment elsewhere is the nested case-control study design.

Conclusion

This updated study confirms earlier findings of an overall favorable mortality experience of employees at the Beaumont (Texas) refinery, when compared with the general US population. In addition, significant mortality deficits were found for several causes of death. For the entire cohort, no significant increase was detected in any cause-specific mortality that could be attributed to employment at the refinery. A non-significant increase in acute myeloid leukemia was observed among male workers. Detailed analyses indicated that the excess was restricted to maintenance workers hired before 1950. No increase was detected for other leukemia cell-types, NHL, or MM. Furthermore, no significant mortality increase was found for other cancers or non-malignant diseases.

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APPENDIX

Job Classification Used in the Beaumont Refinery Cohort

Job Category	Description/Function/Job Units
Administration	Office, professional, managerial.
Engineering/laboratory	Technical research activities.
Process	*Process units:* Crude units, batch/cross stills, gas plants, acid plant, complex unit, light oil treatment, sulfur recovery, fluid catalytic cracker, thermofor catalytic cracker, hourdry, catalytic hydrodesulfurizer, coker, briquette plant, alkylation, methyl-tertiary-butyl-ether, reformer, toluene plant, isomerization, polyform, reformer, ketone, furfural, duosol, blending and packaging, lube plant, effluent water treatment, oil movements, warehouse.
Maintenance/mechanical	*Maintenance support:* Auto shop, boiler, blacksmith, utilities, carpentry, paint, electrical/instrument, insulation/mason, pipe, welding, lead burning, tin, machine, transportation/shipping.

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The Young Surgeon Beside Me

In white-coat-over-green-scrubsuit
Seems far too young, in his running shoes,
To be entrusted with my body, my only one.
Yet here I lie on the examining table
Running out of choices.
I can't delay this encounter any longer,
With what? My infirmity? My fear of surgery?
The decision to go ahead,
So routine for him and his assistants,
Experts in daily tissue alterations.
I've run out of excuses. My gallbladder
Has enough sediment, sands-of-time,
To trigger a colic crisis anytime, anywhere.
My visit is brief, efficient, one blood test,
One probing palpation of my right upper quadrant,
And I see in his clear blue eyes
The three-dimensional textbook image of
"The Biliary Tract With Surrounding Structures."
I receive a hint of a smile, a brief handshake,
As he rushes out the door, beeper in hand,
Late for lunch, or a true emergency?
I button my shirt and jacket, wondering
What can go wrong, again?
Recalling my post-tonsillectomy bleed,
My hydrocele repair-hematoma,
My post-op glaucoma crisis....

How I admire Eve and her descendants
Who know what labor-and-pain is all about,
Women who feel sorry for boys
Who become men, but never lose castration fear.

Then I recall that I was a young MD once,
Superbly trained, confident of my skills
And our teaching-hospital team,
How I skimmed through routine outpatients,
Anticipating real challenges in the amphitheater,
With Death and Danger.
No time for hand-holding
The timorous, irrational soul.

—From Stan Schuman, Mt. Pleasant, S.C.