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Should Cause of Death From the Death Certificate Be Used to Examine Cancer-Specific Survival? A Study of Patients With Distant Stage Disease

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Abstract

Death certificates are used to classify cause of death for studies of cancer survival and mortality. Using data from the National Cancer Institute's Surveillance, Epidemiology, and End Results program, we evaluated cause of death (site-specific, cancer cause-specific, or other cause of death) for 229,181 patients with distant stage disease during 1994–2003 who died by 2005. Agreement between coded cause of death and initial diagnosis was 85% in patients with only one primary and 64% in patients with more than one primary. Our findings support the usefulness of site and cancer cause-specific causes of death reported on the death certificate for distant stage patients with a single cancer.

Keywords

Cancer survival; Cause of death; Mortality; SEER program; Cancer; Death certificate

INTRODUCTION

Cancer-specific and cancer site-specific survival and mortality are important outcomes for tracking trends in population health and evaluating the impact of cancer control interventions, including screening programs and cancer therapies (1–8). In addition, cancer cause-specific and site-specific survival and mortality are frequently used as outcome measures when evaluating the influence of patients' socioeconomic status and clinical characteristics, and provider and hospital characteristics on cancer care. An evaluation of cause-specific survival and mortality requires reliable information on the cause of patients' death. However, an examination of medical records to determine the cause of death is not practical in large cohorts because of the expense and time required for accurate ascertainment. Cause of death as obtained from the death certificate is frequently the only feasible option when using cancer registry databases, large administrative datasets, or large cohorts.

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DECLARATION OF INTEREST

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Validation studies have reported conflicting findings on the reliability of the cause of death from the death certificate, raising concerns about the utility of death certificate data to measure death due to cancer (9–12) and death due to other causes (13, 14). Despite these concerns, death certificate data are used in vital statistics and studies of site-specific and cancer cause-specific survival and mortality. The purpose of this study is to inform the use of the cause of death on death certificates in studies of survival and mortality by examining the cause, cause-specific and site-specific causes of death in a population likely to die of cancer, namely patients with distant stage disease at diagnosis.

METHODS

Data sources and sample population

We used data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program which includes 17 geographic areas, currently representing approximately 26% of the United States (15). The SEER registries collect detailed information on all incident cancers, including cancer site, stage, month and year of diagnosis, and patient demographics. In addition, the SEER registries conduct follow-up to determine vital status by using various methods such as contact with treating physicians, links to state's department of motor vehicles records, links to state's vital records, searches of state's voter registrations, and links to the National Death Index. For patients who have died, the registry data include the month, year, and underlying cause of death reported on the death certificate.

We identified patients diagnosed with cancer of the breast (females only), colon/rectum, stomach, head/neck, liver, lung, melanoma of the skin, ovary, pancreas, prostate, or uterus using SEER*Stat (version 6.4.4). The SEER program collects information on the extent of disease which is used to define SEER localized, regional, and distant historic stages. We restricted the sample to patients diagnosed with SEER historic stage distant disease because this definition does not change over time (16). We selected these sites because these patients were likely to die from cancer than other causes. The most recent five-year relative survival rates for the vast majority of these distant stage cancers were less than 25% (17). We identified 231,613 patients diagnosed with distant stage disease at age 20 or older between 1994 and 2003, who had died by December 31, 2005. We excluded patients whose cancer was first reported at autopsy or on the death certificate (n = 1,432). The final study sample included 229,181 patients.

MEASURES

All measures used in the analysis were obtained from the SEER data. SEER obtains underlying cause of death data from death certificates that are coded by the state health department or state vital records in each SEER region. These death certificates are provided by the states to the National Death Index. For each of the 11 cancer sites, deaths were initially classified into three groups: "site-specific" (e.g., patients with a colorectal cancer diagnosis and colorectal cancer cause of death), "cancer cause-specific, excluding site-specific" (e.g., colorectal cancer diagnosis with a different cancer reported as the cause of death), and "other cause of death" (e.g., tuberculosis, cerebrovascular disease, unknown cause of death). Patients were also categorized as having "one primary only" or "more than one primary." In patients with more than one primary cancer, we reported the incident cancer, which was required to be diagnosed at distant stage for cohort entry. Subsequent cancer diagnoses were not restricted by stage.

Because this is a descriptive study, we were interested in examining variation in reported cause of death by age at diagnosis (20–49, 50–64, 65–74, 75–84, and 85+), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other), sex, and time from diagnosis to death. To determine whether time between diagnosis and death influences the reported cause of death, we categorized the period as 0–11, 12–23, 24–35, and 36–47 months between diagnosis and death. In these analyses, we reported the percentage of diagnosed cancers with “site-specific” and “cancer cause-specific” causes of death coded on the death certificate.

For each of the 11 cancer sites, we initially calculated the percentage of patient deaths that were recorded on the death certificate as site-specific, cancer cause-specific, excluding site-specific, or other cause of death. Because attributing the specific cause of death to patients with more than one cancer diagnosis is difficult, we stratified patients with only one primary cancer and those with more than one primary cancer. Following this initial assessment, we focused on patients with only a single primary cancer. For these patients, we evaluated the cause of death in two ways: site specific and cancer cause-specific causes of deaths. We used chi-square (χ^2) statistics to compare the percentage of all patient deaths reported on death certificates that were attributable to each of the 11 cancer sites by demographic characteristics or time since diagnosis. All statistical tests were two-sided and *p*-values are reported.

RESULTS

Table 1 shows the distribution of the cause of death as reported on the death certificates by cancer site. Of the 229,181 patients included in our analysis, 192,538 (84%) reportedly died from the same site-specific cancer as their incident diagnosis in SEER. An additional 8% were reported to have died of another cancer. Less than 9% of the sample had a cause of death listed as other than cancer. Among patients with only one primary cancer recorded, there was substantial agreement between incident cancer site diagnosis and reported cause of death. For patients with a single primary diagnosis, the percentage of deaths attributable to site-specific cancers exceeded 80% for lung (87%), pancreatic (87%), breast (85%), and ovarian (85%) cancers. The poorest agreement was for patients with head and neck (58%), liver (71%), and uterine (72%) cancers. For patients with only one cancer diagnosis, the cause of death was recorded as cancer (either site-specific or cancer cause-specific, excluding site-specific) in at least 85% of all cases, for 9 of the 11 cancer sites, included in our analysis. The exceptions were for prostate (78%) and head and neck (84%) cancer.

When the “cancer cause-specific, excluding site-specific” category represented more than 10% of all deaths and the patient was diagnosed with only one primary cancer, we identified the most commonly coded cancer sites on the death certificate. Among patients with a primary diagnosis of melanoma of the skin, liver, or head and neck cancer, the most frequently coded other cancer cause of death was miscellaneous malignant cancers (C26.1, C45.7, C45.9, C76-C80, C88, C96.0-C96.2, C96.7, C96.9, C97), with 46%, 57%, and 61%, respectively. Among patients diagnosed with melanoma of the skin, another 17% were coded as lung and bronchus. An additional 15% of liver cancer patients were coded as intrahepatic bile duct deaths. Head and neck cancer patients with another cancer cause of death were attributed to skin, excluding basal or squamous cell, 13%, or lung or bronchus, 11%. Among gastric cancer patients, 59% were reported to be an esophageal cancer cause of death with another 18% classified as miscellaneous malignant cancers. Nearly 53% of uterine cancer patients were reported with another female gynecologic cancer cause of death on the death certificate.

The percentage of patients with agreement between the initial diagnosis and site-specific cause of death was lower for patients with multiple primaries. For these patients, the site-specific cause of death agreed in 66–75% of patients with pancreatic, lung, breast, colorectal cancers, and melanoma of the skin. Patients with prostate and head and neck cancers who had multiple primaries had the lowest reported site-specific cancer deaths, 39% and 36%, respectively. However, the percentage of patients with multiple cancers who reportedly died of cancer of any site was high at 90%.

Because of the challenges in attributing cancer deaths for patients with multiple cancers, we restricted additional analyses to patients with only one primary cancer diagnosis. We considered, by cancer site, whether the percentages of deaths attributable to site-specific cancers, cancer cause-specific, or other causes differed by age, race/ethnicity, and sex. As shown in Table 2, for all cancers, the percentage of patients dying from causes other than cancer increased with age, and the trend was statistically significant for all cancer sites ($p <.05$), except liver. For the vast majority of cancers, black and Hispanic patients were more likely than white patients to have a reported cause of death other than cancer. The percentage of deaths recorded on the death certificate as site-specific or any cancer cause of death did not vary by sex, except for gastric cancer where women had a higher percentage of site-specific cancer cause of death (data not shown).

We examined whether the cause of death on the death certificate varied with the length of time from diagnosis to death (Table 3). For most cancers, percentages of reported site-specific and cancer cause-specific deaths remained comparable across time. For colorectal, lung, and prostate cancers, the percentages of patients with site-specific cancer causes of death varied by time from diagnosis to death ($p <.001$), generally increasing through year one and decreasing through years two and three. In ovarian cancer patients, the site-specific percentage mono-tonically increased as time from diagnosis to death increased ($p <.001$).

DISCUSSION

Our analysis has shown that in a population of patients likely to die from cancer (i.e., patients diagnosed with distant stage disease), the percentage of deaths attributable to any cancer as reported on the death certificate is high. The vast majority of patients (84%) were reported as dying from the same site-specific cancer as diagnosed, and a smaller percentage (8%) reportedly died of another cancer. We found that agreement on cause of death as coded on the death certificate was higher for patients who had a single primary than for those with multiple primaries.

In a prior study, medical records and SEER tumor registry data for prostate cancer patients were used to evaluate the accuracy of New Mexico Bureau of Vital Statistics death determinations for the years 1985 and 1995 (18). The study found high agreement in both years between the New Mexico Bureau of Vital Statistics death determinations and the medical record abstraction. Discordance between the New Mexico Bureau of Vital Statistics and the medical abstract review was most common among patients with multiple primary cancer diagnoses. Taken together, these findings suggest that studies using death certificates to identify site-specific deaths should be restricted to patients with a single primary only. The issue of multiple cancer primaries is of growing significance in the United States as the number of cancer survivors has increased and the population is growing and aging (19). For patients diagnosed with cancer at the age of 65 years and older from 1998 to 2003, 23% had two or more primary cancers (17). Limiting the sample to patients with a single primary cancer will result in reduced generaliz-ability, however, especially for studies of cancer in the older age groups. Given the sizeable number of elderly cancer patients with multiple primaries, researchers should perform sensitivity analyses to determine how the exclusion of these patients would impact their findings.

For studies that include patients with only one primary cancer, the cause of death can be limited to site-specific deaths only or expanded to include all cancer deaths. An earlier analysis of the cause of death found that physicians tended to report a nonspecific site of cancer on the death certificate (1). The authors of the earlier analysis concluded that cancer patients who have a single primary cancer diagnosis and an “other” cancer cause of death reported on the death certificate are likely miscoded and that the cause of death for these patients should be attributed to the specific cancer site. Our findings suggest that this approach for patients with a single primary cancer diagnosis is reasonable.

Data from cancer registries, such as SEER, are often used to assess the effectiveness of screening and treatment programs on survival. Accurate cause of death reporting is essential for estimating site- and cancer-specific mortality and survival. A prior analysis of the accuracy of cancer death certificates noted misclassification problems particularly for colon, rectal, and uterine cancers (1). In our analysis of patients with a single primary advanced colorectal cancer, agreement with the site-specific cause of death was 85%. However for several sites, misclassification of the site-specific cause of death appeared greater. For women with a single primary advanced stage uterine cancer, 18% had another cancer site coded as the cause of death (of which nearly 53% were other gynecologic sites). Among patients with melanoma of the skin or head and neck cancer, the other cancer causes of deaths reported on the death certificate were frequently the nonspecific miscellaneous malignant cancers. This suggests that the physician signing the death certificate may have been uncertain of the site of origin of the cancer or unfamiliar with the patient’s medical history; therefore, the physician used a more general cancer site code.

It is primarily the research, vital and health statistics, and health policy communities that are interested in the specific details of cancer cause of death. The process of determining the underlying cause of death reported on a death certificate requires a number of steps. First, a certifying physician records multiple causes of death for a decedent and arranges them in a sequence to reflect the etiologic relationship of the medical conditions that led to death. Since the early 1970s, a software program, the Automated Classification of Medical Entities (ACME), has been used as a primary method for determining cause of death by taking into account the information on all medical conditions and their relationships to one another for the reported death. The software selects from among all conditions reported by the physician to determine the appropriate cause of death. The 10–15% of deaths that cannot be properly classified using ACME are then manually adjudicated by a trained nosologist (20). This process helps to ensure that causes of death reported on death certificates are as accurate as possible. A recent study of lung cancer mortality by Doria-Rose *et al*. found that the cause of death reported on the death certificates had an 89% sensitivity and 99% specificity compared to the cause of death determined by a mortality review committee. Their analysis reported that the use of the cause of death from the death certificate compared to the mortality review board determination did not produce a meaningful change in mortality-based outcomes (9).

Some researchers have used overall survival rather than cancer-specific survival for studies of cancer patients (7, 8). Because overall survival includes deaths due to conditions other than cancer, its use can be problematic. This is especially true among the elderly population, which has the highest incidence of cancer. In our analysis, we observed that for 10 of 11 cancers, the portion of patients dying from conditions other than cancer increased with age. In addition, we found that for many cancers, black and Hispanic patients were more likely than white patients to die from conditions other than cancer. These findings underscore the limitations of using all deaths, rather than cancer-specific deaths as a measure of treatment or screening outcomes for cancer patients. It is important to note, however, that overall mortality is a relevant endpoint to consider when assessing the effectiveness of cancer therapies that may increase the risk of other noncancer adverse outcomes (e.g., heart failure) and should be reported alongside cancer-specific mortality.

The major strengths of this study include the large population-based sample, 10 years of detailed data, and consistency of findings across cancer sites. However, our study also has some limitations. To improve our ability to assess the cause of death on death certificates, we restricted our analysis to cancer patients diagnosed with distant stage disease who died. Therefore, we are unable to directly extrapolate our results to cancer patients diagnosed at earlier stages. Yet, for many cancers, sizeable portions are diagnosed with distant stage disease—51% for lung cancers and 67% for ovarian cancers (17). Lastly, we assumed that patients diagnosed with distant stage cancer were likely to die from their diagnosed cancer. However, we did not have access to medical record data to confirm this assumption.

An advantage of using the cause of death information obtained from the death certificate is that the cost of acquiring these data is relatively low. Although the medical record may provide more detailed information about the cause of death, the incremental expense and time required to abstract medical records may be prohibitive for many studies. With growing use of electronic health records, it may eventually be feasible to obtain cause of death information from the medical record, although concerns about patient confidentiality may limit access to them. In the absence of such data, our findings support the usefulness of the cause of death reported on the death certificate to determine the cause-specific and site-specific cause of death for most cancers reported for patients with single, distant stage | primaries.

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Table 1

Cause of Death Reported by Number of Primary Cancers for Patients Diagnosed With Distant Stage Cancer From 1994 to 2003 and Who Were Deceased as of December 31, 2005

	All primaries		One primary only		More than one primary*	
Cancer Site – Cause of Death Reported	***n***	**%**	***n***	**%**	***n***	**%**
Total – All 11 Cancer Sites	229, 181	100.0	222, 385	100.0	6, 796	100.0
Site-specific	192, 538	84.0	188, 176	84.6	4, 362	64.2
Other malignant cancers, excluding site-specific	17, 743	7.7	17, 941	8.1	1, 768	26.0
Other cause of death†	18, 900	8.2	18, 234	8.2	666	9.8
Breast Cancer	12, 361	100.0	11, 472	100.0	889	100.0
Site-specific	10, 424	84.3	9, 790	85.3	634	71.3
Other malignant cancers, excluding site-specific	697	5.6	535	4.7	162	18.2
Other cause of death†	1, 240	10.0	1, 147	10.0	93	10.5
Colorectal Cancer	33, 469	100.0	31, 751	100.0	1, 718	100.0
Site-specific (Colon)	24, 859	74.3	23, 721	74.7	1, 138	66.2
Site-specific (Rectal)	3, 550	10.6	3, 400	10.7	150	8.7
Other malignant cancers, excluding site-specific	2, 369	7.1	2, 088	6.6	281	16.4
Other cause of death†	2, 691	8.0	2, 542	8.0	149	8.7
Gastric Cancer	10, 826	100.0	10, 634	100.0	192	100.0
Site-specific	8, 059	74.4	7, 951	74.8	108	56.3
Other malignant cancers, excluding site-specific	2, 000	18.5	1, 935	18.2	65	33.9
Other cause of death†	767	7.1	748	7.0	19	9.9
Head/Neck Cancer	3, 731	100.0	3, 424	100.0	307	100.0
Site-specific	2, 108	56.5	1, 997	58.3	111	36.2
Other malignant cancers, excluding site-specific	1, 053	28.2	890	26.0	163	53.1
Other cause of death†	570	15.3	537	15.7	33	10.7
Liver Cancer	3, 811	100.0	3771	100.0	40	100.0
Site-specific	2, 699	70.8	2680	71.1	19	47.5
Other malignant cancers, excluding site-specific	699	18.3	683	18.1	16	40.0
Other cause of death†	413	10.8	408	10.8	5	12.5
Lung Cancer	113, 145	100.0	111, 201	100.0	1, 944	100.0

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Cancer Site – Cause of Death Reported	All primaries		One primary only		More than one primary*	
	n	**%**	***n***	**%**	***n***	**%**
Site-specific	98, 430	87.0	97, 139	87.4	1, 291	66.4
Other malignant cancers, excluding site-specific	6, 414	5.7	5, 932	5.3	482	24.8
Other cause of death†	8, 301	7.3	8, 130	7.3	171	8.8
Melanoma of the skin	2, 029	100.0	1, 943	100.0	86	100.0
Site-specific	1, 587	78.2	1, 526	78.5	61	70.9
Other malignant cancers, excluding site-specific	287	14.1	271	13.9	16	18.6
Other cause of death†	155	7.6	146	7.5	9	10.5
Ovarian Cancer	14, 800	100.0	14, 197	100.0	603	100.0
Site-specific	12, 444	84.1	12, 055	84.9	389	64.5
Other malignant cancers, excluding site-specific	1, 288	8.7	1, 124	7.9	164	27.2
Other cause of death†	1, 068	7.2	1, 018	7.2	50	8.3
Pancreatic Cancer	21, 104	100.0	20, 890	100.0	214	100.0
Site-specific	18, 363	87.0	18, 221	87.2	142	66.4
Other malignant cancers, excluding site-specific	1, 656	7.8	1, 601	7.7	55	25.7
Other cause of death†	1, 085	5.1	1, 068	5.1	17	7.9
Prostate Cancer	10, 287	100.0	9, 624	100.0	663	100.0
Site-specific	7, 450	72.4	7, 192	74.7	258	38.9
Other malignant cancers, excluding site-specific	580	5.6	284	3.0	296	44.6
Other cause of death†	2, 257	21.9	2, 148	22.3	109	16.4
Uterine Cancer	3, 618	100.0	3, 478	100.0	140	100.0
Site-specific (Corpus Uteri)	1, 284	35.5	1, 255	36.1	29	20.7
Site-specific (Uterine, NOS)	1, 281	35.4	1, 249	35.9	32	22.9
Other malignant cancers, excluding site-specific	700	19.3	632	18.2	68	48.6
Other cause of death†	353	9.8	342	9.8	11	7.9

*More than one primary denotes that the specific cancer is the first of multiple primaries.

†Other cause of death includes death from causes other than cancer and cancers with *in situ*, benign, or unknown neoplasm behavior.

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Table 2

Selected Demographic Characteristics for Patients Diagnosed With Only One Primary Distant Stage Cancer From 1994 to 2003 and Who Had Died as of December 31, 2005

		Age						Race/Ethnicity*				
	Total Deaths	20–49 Years Old	50–64 Years Old	65–74 Years Old	75–84 Years Old	>85 Years Old	*p*-Value[b]	White Non-Hispanic	Black Non-Hispanic	Hispanic	Other	*p*-Value[§]
Breast Cancer – Total Deaths (n)	11, 472	2, 319	3, 654	2, 394	2, 168	937		8, 172	1, 582	993	671	
Breast Cancer COD (%)	85.3	90.8	89.8	83.6	79.2	72.9	<0.01	85.2	86.3	84.8	85.2	0.97
All Cancer COD (%)	90.0	94.3	93.8	88.9	84.8	79.4	<0.01	90.1	90.1	89.2	89.6	0.99
Other cause of death (%)	10.0	5.7	6.2	11.1	15.2	20.6	<0.01	9.9	9.9	10.8	10.4	0.84
Colorectal Cancer – Total Deaths (n)	31, 751	3, 410	8, 351	8, 398	8, 263	3, 329		23, 140	3, 620	2, 488	2, 402	
Colorectal Cancer COD (%)	85.4	89.9	89.3	86.1	82.2	77.4	<0.01	85.8	84.6	83.6	85.0	0.65
All Cancer COD (%)	92.0	95.9	94.8	92.3	89.7	85.9	<0.01	92.4	91.7	91.1	90.0	0.65
Other cause of death (%)	8.0	4.1	5.2	7.7	10.3	14.1	<0.01	7.6	8.3	8.9	10.0	<0.01
Gastric Cancer – Total Deaths (n)	10, 634	1, 571	2, 976	2, 828	2, 510	749		6, 017	1, 231	1, 727	1, 618	
Gastric Cancer COD (%)	74.8	77.0	72.8	73.4	76.3	78.0	0.29	70.2	76.0	81.4	84.0	<0.01
All Cancer COD (%)	93.0	94.1	93.9	93.0	91.7	90.8	0.85	94.4	91.1	90.8	91.5	0.38
Other cause of death (%)	7.0	5.9	6.1	7.0	8.3	9.2	0.01	5.6	8.9	9.2	8.7	<0.01
Head / Neck Cancer - Total Deaths (n)	3, 424	542	1, 285	870	575	152		2, 303	580	273	253	
Head/Neck Cancer COD (%)	58.3	62.0	60.0	57.5	53.7	53.3	0.32	57.1	57.4	65.2	64.0	0.23
All Cancer COD (%)	84.3	88.7	88.1	82.8	75.7	78.3	0.05	83.9	85.2	86.8	84.2	0.96
Other cause of death (%)	15.7	11.3	11.9	17.2	24.3	21.7	<0.01	16.1	14.8	13.2	16.4	0.65
Liver Cancer - Total Deaths (n)	3, 771	642	1, 354	922	679	174		1, 822	436	608	884	
Liver Cancer COD (%)	71.1	74.1	72.2	70.8	67.9	64.4	0.53	70.1	71.1	68.1	75.0	0.41
All Cancer COD (%)	89.2	89.7	88.3	88.4	90.9	92.0	0.97	91.2	89.0	84.5	88.5	0.51
Other cause of death (%)	10.8	10.3	11.7	11.6	9.1	8.0	0.31	8.8	11.0	15.5	11.6	<0.01
Lung Cancer - Total Deaths (n)	111, 201	7, 813	33, 678	36, 432	26, 999	6, 279		85, 852	11, 515	5, 795	7, 595	
Lung Cancer COD (%)	87.4	88.1	89.8	87.6	85.4	80.5	<0.01	87.9	85.3	86.2	85.8	0.01
All Cancer COD (%)	92.7	95.3	94.8	92.6	90.7	87.2	<0.01	93.1	91.4	92.3	90.6	0.07
Other cause of death (%)	7.3	4.7	5.2	7.4	9.3	12.8	<0.01	6.9	8.6	7.7	9.5	<0.01
Melanoma – Total Deaths (n)	1, 943	488	572	392	367	124		1, 761	31	99	42	

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		Age						Race/Ethnicity*				
	Total Deaths	20–49 Years Old	50–64 Years Old	65–74 Years Old	75–84 Years Old	>85 Years Old	*p*-Value[b]	White Non-Hispanic	Black Non-Hispanic	Hispanic	Other	*p*-Value[§]
Melanoma COD (%)	78.5	85.2	82.9	76.5	71.4	59.7	0.02	79.3	58.1	73.7	76.2	0.55
All Cancer COD (%)	92.5	96.1	95.8	93.9	86.1	77.4	0.19	93.1	83.9	88.9	83.3	0.84
Other cause of death (%)	7.5	3.9	4.2	6.1	13.9	22.6	<0.01	6.9	16.1	11.1	15.4	0.02
Ovarian Cancer - Total Deaths (n)	14, 197	1, 804	4, 011	3, 748	3, 476	1, 158		11, 187	941	1, 145	883	
Ovarian Cancer COD (%)	84.9	89.1	87.7	84.9	82.1	77.1	<0.01	85.8	80.6	81.2	83.4	0.16
All Cancer COD (%)	92.8	95.2	94.7	92.4	91.1	89.3	0.25	93.3	92.1	91.1	90.2	0.7
Other cause of death (%)	7.2	4.8	5.3	7.6	8.9	10.7	<0.01	6.7	7.9	8.9	9.8	<0.01
Pancreatic Cancer – Total Deaths (n)	20, 890	1, 688	5, 836	6, 296	5, 342	1, 728		15, 221	2, 276	1, 750	1, 547	
Pancreatic Cancer COD (%)	87.2	86.7	88.7	87.8	86.4	83.4	0.29	88.5	84.1	83.4	83.7	0.01
All Cancer COD (%)	94.9	95.6	95.8	95.1	94.3	92.1	0.7	95.6	93.3	92.9	92.4	0.37
Other cause of death (%)	5.1	4.4	4.2	4.9	5.7	7.9	<0.01	4.4	6.7	7.1	7.3	<0.01
Prostate Cancer – Total Deaths (n)	9, 624	205	1, 860	2, 727	3, 326	1, 506		6, 415	1, 573	869	646	
Prostate Cancer COD (%)	74.7	91.7	85.1	74.9	71.4	66.7	<0.01	75.3	76.4	73	69.5	0.32
All Cancer COD (%)	77.7	94.6	88.0	77.9	74.4	69.5	<0.01	78.3	79.3	76.1	71.7	0.25
Other cause of death (%)	22.3	5.4	12.0	22.1	25.6	30.5	<0.01	21.7	20.7	23.9	29.1	<0.01
Uterine Cancer – Total Deaths (n)	3, 478	349	1, 157	951	792	229		2, 395	470	320	274	
Uterine Cancer COD (%)	72.0	69.3	75.0	73.0	69.2	66.4	0.43	73.3	65.5	71.9	71.9	0.35
All Cancer COD (%)	90.2	94.0	93.0	90.7	86.2	81.2	0.29	91.1	86.0	90.6	89.1	0.76
Other cause of death (%)	9.8	6.0	7.0	9.3	13.8	18.8	<0.01	8.9	14.0	9.4	10.9	0.01

* Unknown race/ethnicity is not reported due to small numbers.

§ The data were analyzed using a two-sided χ^2 test of independence across the categories of each variable.

Table 3

Cause of Death Reported for Patients Diagnosed With Only One Primary Distant Stage Cancer From 1994 to 2003 and Who Were Deceased as of December 31, 2005, by Time From Diagnosis to Death

Time From Diagnosis to Death	0–11 Months		12–23 Months		24–35 Months		36–47 Months		χ^2	*p*-Value*
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**		
Breast Cancer (female only)	5, 179		2, 651		1, 672		927			
Breast Cancer COD	4, 302	83.1	2, 336	88.1	1, 476	88.3	809	87.3	7.6	0.06
All Cancer COD	4, 658	89.9	2, 421	91.3	1, 524	91.1	833	89.9	0.5	0.92
Colorectal Cancer	20, 029		6, 982		2, 862		1, 046			
Colorectal Cancer COD	16, 776	83.8	6, 294	90.1	2, 571	89.8	894	85.5	30.5	< 0.001
All Cancer COD	18, 364	91.7	6, 585	94.3	2, 670	93.3	952	91.0	4.3	0.23
Gastric Cancer	8, 887		1, 293		292		93			
Gastric Cancer COD	6, 731	75.7	937	72.5	191	65.4	58	62.4	7.3	0.06
All Cancer COD	8, 294	93.3	1, 198	92.7	264	90.4	83	89.2	0.5	0.93
Head/Neck Cancer	2, 061		806		239		127			
Head/Neck Cancer COD	1, 229	59.6	490	60.8	137	57.3	61	48.0	3.2	0.36
All Cancer COD	1, 781	86.4	723	89.7	186	77.8	87	68.5	7.7	0.05
Liver Cancer	3, 441		223		72		21			
Liver Cancer COD	2, 459	71.5	154	69.1	45	62.5	15	71.4	0.9	0.82
All Cancer COD	3, 076	89.4	198	88.8	62	86.1	17	81	0.3	0.97
Lung Cancer	90, 931		14, 906		3, 541		1, 008			
Lung Cancer COD	79, 238	87.1	13, 451	90.2	3, 051	86.2	844	83.7	16.5	< 0.001
All Cancer COD	84, 380	92.8	14, 000	93.9	3, 205	90.5	889	88.2	6.3	0.1
Melanoma	1, 408		324		115		53			
Melanoma COD	1, 104	78.4	260	80.2	96	83.5	39	73.6	0.6	0.89
All Cancer COD	1, 326	94.2	296	91.4	105	91.3	41	77.4	1.7	0.63
Ovarian Cancer	6, 293		3, 033		2, 156		1, 219			
Ovarian Cancer COD	4, 997	79.4	2, 713	89.4	1, 946	90.3	1, 109	91.0	42.4	< 0.001
All Cancer COD	5, 762	91.6	2, 868	94.6	2, 039	94.6	1, 153	94.6	3.1	0.38
Pancreatic Cancer	18, 838		1, 540		306		107			
Pancreatic Cancer COD	16, 451	87.3	1, 378	89.5	248	81.0	76	71.0	5.5	0.14
All Cancer COD	17, 905	95	1, 467	95.3	275	89.9	93	86.9	1.6	0.66

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Time From Diagnosis to Death	0–11 Months		12–23 Months		24–35 Months		36–47 Months		χ^2	*p*-Value*
	n	%	*n*	%	*n*	%	*n*	%		
Prostate Cancer	3, 483		2, 679		1, 477		825			
Prostate Cancer COD	2, 544	73.0	2, 153	80.4	1, 124	76.1	613	74.3	11.0	0.01
All Cancer COD	2, 694	77.3	2, 216	82.7	1, 159	78.5	629	76.2	6.7	0.08
Uterine Cancer	2, 054		780		334		156			
Uterine Cancer COD	1, 512	73.6	560	71.8	239	71.6	114	73.1	0.4	0.95
All Cancer COD	1, 885	91.8	705	90.4	301	90.1	139	89.1	0.3	0.97

*The data were analyzed using a two-sided χ^2 test of independence across the categories of time from diagnosis to death, $p<.05$.