



Causes of Death Among People Diagnosed with Cancer Montana Central Tumor Registry, 1980 - 2004

Cancer is typically a diagnosis of late middle age and older, when many individuals have other health conditions to contend with. In particular, cardiovascular disease, diabetes, chronic respiratory diseases, and various dementias increase in prevalence with age and many cancer patients ultimately die of these or other causes. As cancer diagnosis and treatment improve, the proportion of cancer patients who will survive their cancer to die from other causes can be expected to increase.

The Montana Central Tumor Registry (MCTR) collects information on cancer diagnosis, treatment, survivorship, and cause of death for Montana residents. The four most common incident cancers in Montana are prostate (19% of all cases), lung and bronchus (15%), female breast (14%), and colorectal (10%), together accounting for 58% of all cases. Other kinds of cancer each account for 5% or less of all cases and many kinds account for less than 1%.

The MCTR has excellent ascertainment of death and cause of death for cancer patients through annual linkage with the Montana Office of Vital Statistics. In addition, the MCTR completed nationwide linkage with the Social Security Death Index¹ and the National Death Index² in December, 2009. This resulted in adding vital status and cause of death for 16% of patients in the MCTR, primarily patients who were Montana residents at diagnosis but who had moved out of state and been lost to follow-up before they died.

A total of 65,090 (61%) of patients diagnosed between January 1, 1980 and December 31, 2004 were known to be dead as of December 31, 2009. Fifteen percent of decedents were excluded from this analysis because their cancer was ascertained from autopsy reports or death certificates only, or because the MCTR still lacks information on cause of death. This report focuses on the 56,914 decedents in the MCTR with complete clinical and mortality data, or 54% of the patients diagnosed between 1980 and 2004.

We grouped causes of death into Major Diagnostic Categories, the broad categories used by the International Classification of Diseases and Related Health Problems, 9th Revision (ICD-9) for

¹ <http://govdeathrecords.com/?tid=dr12&gclid=CMqhbbufp58CFRwTagodJTcW0w>

² <http://www.cdc.gov/nchs/ndi.htm>

deaths before 1999 and ICD-10 for deaths in 1999 and later.³ There were many changes in the details of cause of death coding between the 9th and 10th revisions but the broad categories did not change substantially. We examined causes of death for all decedents who were diagnosed with cancer at any site, and for decedents who were diagnosed with lung and bronchus, colorectal, breast (female), and prostate (male) cancers separately (Table 1).

Overall, 28.7% of all patients diagnosed with cancer died of causes other than cancer. This proportion varied substantially across the major sites. Only 10.8% of patients diagnosed with lung cancer died of other causes, but 35.1% of patients with colorectal cancer, 39.7% of women with breast cancer, and 48.4% of men with prostate cancer died of causes other than cancer. The most common causes of non-cancer death were diseases of the cardiovascular system (predominantly heart disease and stroke). Death from heart disease was especially common among men with prostate cancer and accounted for more than a quarter of those deaths. Other causes of death, including diseases of the respiratory system (such as chronic obstructive pulmonary disease, emphysema, and chronic bronchitis), diseases of the nervous system (Alzheimer's disease, Parkinson's disease), mental disorders (nonspecific dementias), and diabetes, were less common.

Table 1. Percent of Cancer Patients Dying of Selected Causes by Cancer Site, Montana Central Tumor Registry, Diagnosed 1980 - 2004

	All Sites	Lung/ Bronchus	Colorectal	Breast (female)	Prostate (male)
Cause of Death					
Cancer	71.3	89.2	64.9	60.3	51.6
Cardiovascular system	14.7	5.1	18.5	19.9	26.8
Respiratory system	5.4	3.4	5.9	6.9	8.6
Digestive system	1.6	~	2.0	2.5	1.9
Endocrine system †	1.3	~	1.7	1.7	1.5
Nervous system ‡	1.1	~	1.3	1.8	2.0
Injury, other external causes	~	~	1.1	~	1.4
Genitourinary system #	~	~	~	1.5	1.5
Mental disorders §	~	~	1.1	1.3	~
TOTAL	95.4	97.7	96.5	95.9	95.3

† 73% attributed to diabetes and its complications

‡ 71% attributed to Alzheimer's disease or Parkinson's disease

83% attributed to kidney disease

§ 72% attributed to nonspecific dementias

~ Category accounted for < 1% of deaths

³ <http://www.who.int/classifications/icd/en>

Several factors besides type of cancer contribute to the likelihood of dying of cancer rather than some other cause (Table 2). For all sites combined, women were slightly more likely to die of cancer than men. Patients diagnosed at younger ages were more likely to die of cancer than patients diagnosed at older ages. Patients diagnosed at the distant stage were much more likely to die of cancer than those diagnosed at the local stage. It is striking that the longer a patient survived after diagnosis, the more likely he or she was to die of a cause other than cancer. Apart from a lack of sex difference in cause of death among patients with colorectal cancer, these patterns were consistent for the individual cancer sites examined as well. Time period of diagnosis (1980-89, 1990-99, and 2000-04) was not associated with the likelihood of dying of cancer or some other cause.

Table 2. Percent of Cancer Patients Dying of Cancer by Selected Characteristics, Montana Central Tumor Registry, Diagnosed 1980 - 2004

	All Sites		Lung/ Bronchus		Colorectal		Breast (female)		Prostate (male)	
Sex										
Male	70.4	.001†	88.6	.05	65.7	ns				
Female	72.3		90.2		63.8					
Age at Diagnosis										
< 45 years	87.9	.001	97.0	.001	93.7	.001	95.1	.001	^	.01
45-59 years	85.1		92.7		84.4		84.5		70.8	
60-74 years	72.5		88.5		67.9		58.9		54.1	
≥ 75 years	61.4		87.8		56.1		38.2		46.0	
Stage at Diagnosis										
Local	51.8	.001	74.7	.001	40.1	.001	37.7	.001	35.7	.001
Regional	77.7		87.9		68.0		63.3		53.0	
Distant	90.5		95.9		95.2		88.1		73.6	
Survival after Diagnosis										
< 1 year	87.2	.001	93.6	.001	79.9	.001	69.2	.001	55.2	.001
1-4.9 years	73.4		88.1		73.9		70.0		56.2	
5.0-9.9 years	52.1		57.8		42.8		55.6		49.7	
≥ 10 years	39.7		38.3		25.9		44.4		41.7	

† Significance levels from 2x2, 2x3, or 2x4 chi square tests

^ Fewer than 20 cases per cell

Because the risk factors in Table 2 are not independent of each other -- for example, women tended to be diagnosed at older ages and later stages than men; later stage at diagnosis tended to be correlated with shorter survival after diagnosis -- we used multiple logistic regression to examine the independent effect of each variable (sex, age at diagnosis, stage, and survival time), controlling for all the other variables. There were minor changes in the patterns of cause of death. Men were 26% *more* likely than women to die from lung cancer when controlling for other variables. After controlling for other variables, and especially controlling for stage at diagnosis, earlier age at diagnosis *reduced* the risk of dying from colorectal cancer. This may be attributable to the beneficial effects of diagnosis by colonoscopy and the removal of cancerous polyps at a very early stage, preventing the progression of colorectal cancer.

Because the Montana Central Tumor Registry only recently began collecting detailed data about comorbidities among cancer patients in a systematic way, we could not perform a rigorous analysis of competing causes of death⁴ among Montana cancer patients. However, it seems likely that patients who are older at diagnosis are more likely than younger patients to have other serious health problems besides their cancer. It also seems likely that patients who had short survival times may have had more aggressive tumors or less vigorous response to treatment than patients who had longer survival times. The effect of late stage at diagnosis on the likelihood of dying of cancer is well established. Our results were similar to those published for other cohorts of men with prostate cancer,⁵ women with breast cancer,⁶ and patients with cancer of the upper urinary tract,⁷ in which formal competing-cause analysis was possible.

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⁴ Fiocco M et al., 2005. *Biostatistics* 6:465-478.

⁵ Albertson PC et al., 1998. *JAMA* 280:975-980; Satariano WA et al., 1998. *Cancer* 83:1180-1188; Newschaffer CJ et al., 2000. *JNCI* 92:613-621.

⁶ Schairer et al., 1004. *JNCI* 96:1311-1321; Hanrahan EO, et al., 2007. *J Clin Oncol* 25:4952-4960; Chapman JW et al., 2008. *JNCI* 100:252-260.

⁷ Inman BA et al., 2009. *Cancer*

<http://www3.interscience.wiley.com/journal/122381056/abstract?CRETRY=1&SRETRY=0>