Diabetes Mortality in Vermont

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Introduction

Diabetes remains a leading cause of mortality in the U.S., and deaths are increasing. Diabetes was the seventh leading cause of death in the U.S. in 1994. Increased death rates are seen for all ages and races, and the highest rates are seen among minority populations and older Americans. Diabetes is ranked as the seventh leading cause among whites, blacks, Chinese, and Filipinos. Diabetes-related death rates were higher among American Indians, blacks, and persons of Hispanic origin than among whites, with black females having the highest rates[1].

In the U.S., the annual number of deaths for which diabetes was the underlying cause increased from 34,851 in 1980 to 56,692 in 1994. Throughout most of the 1980s, the age-adjusted diabetes death rate remained relatively constant. However, in 1989 (the year a new standard death certificate was implemented in the United States), the age-adjusted diabetes death rate increased 14% and continued to increase in the l990s, although at a slower rate (11% increase between 1989 and 1994). By 1994, the age-adjusted diabetes death rate was 27% higher than in 1980 (19.5 per 100,000 v. 15.3 per 100,000, respectively)[1].

The annual number of diabetes-related, U.S. deaths increased from 135,931 in 1980 to 182,261 in 1994. In contrast to the age-adjusted diabetes death rate, the age-adjusted diabetes-related death rate did not display a large increase in 1989 and only increased 4% between 1980 and 1994[1].

Since much of the analyses in this report rely on death certificate data, one must consider how accurately death certificates record the fact that the deceased is a diabetic. In a follow-up study[2] of a national cohort from the NHANES I study, there is an interesting observation that among diabetics, diabetes does not often appear on the death certificates. Among male diabetics who were not alive at follow-up, 7.7 percent had diabetes listed as underlying and 36 percent as any cause of death. Among female diabetics who were not alive at follow-up, 13.4 percent had diabetes listed as underlying and 47.2 percent as any cause of death. This may have to with the difference between death certificate recording of co-morbid conditions rather than just apparent causes. Efforts are underway at the Vermont Department of Health to assess the accuracy of the death certificates in Vermont.

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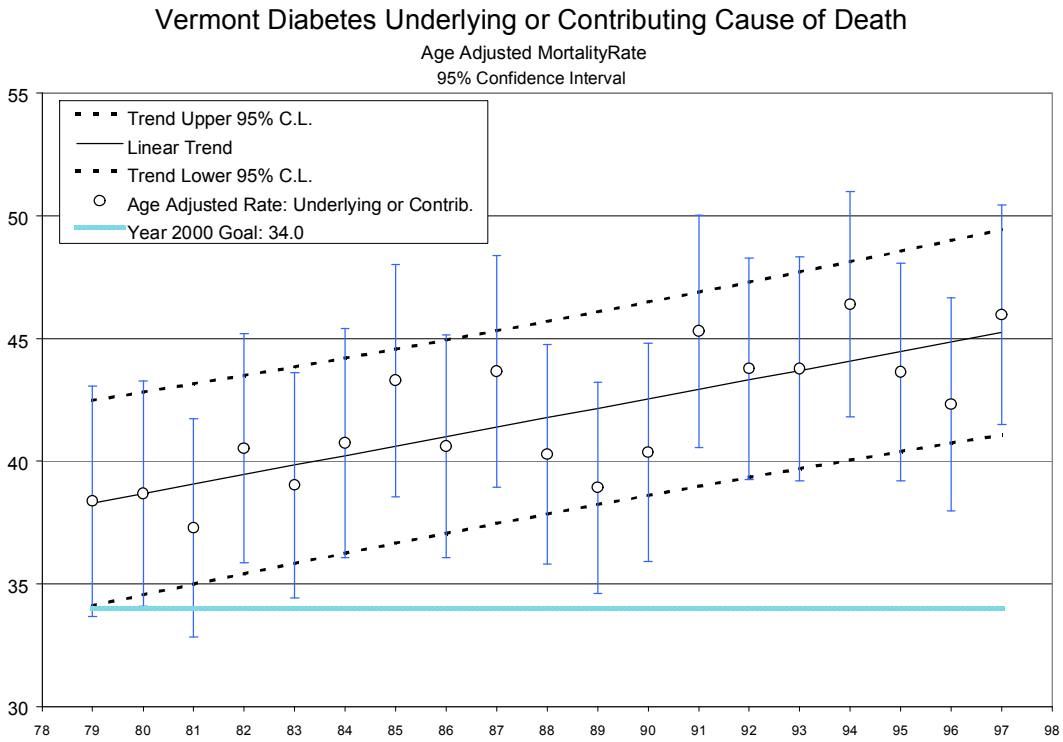
[1]Surveillance Report: Chapter 1: The Public Health of Diabetes Mellitus in the United States. CDC 1997

[2]Mortality in adults with and without diabetes in a national cohort of the U.S. population, 1971-1993, Gu K; Cowie CC; Harris MI. *Diabetes Care* 1998 Jul;21(7):1138-45

Mortality with Diabetes as the Underlying or Contributing Cause:

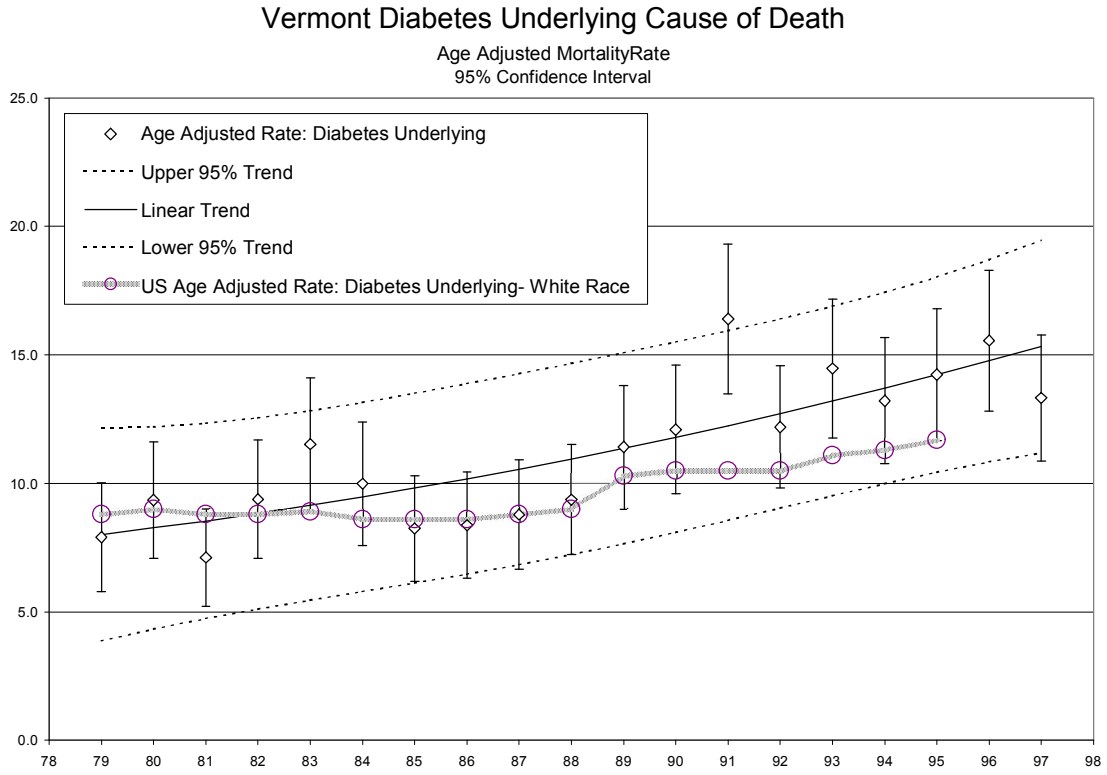
Over the last eighteen years, mortality from diabetes has had a significant upward trend. For the time period 1993-97 the age-adjusted mortality from diabetes either as the underlying or as a contributing cause of death was 44.4 per 100,000 population, or between 40.5 and 48.3[3] given statistical fluctuation. Unfortunately, the long-term trend has been away from the Year 2000 Goal of an age-adjusted mortality rate of 34 per 100,000 population.



[3] 95 % Confidence interval

Mortality with Diabetes as the Underlying Cause:

Over the period 1993-97, the age-adjusted mortality from diabetes as the underlying cause of death has been 13.3 per 100,000 or between 11.2 and 19.5 given statistical fluctuation[4]. This value is essentially the same as the US age-adjusted diabetes mortality for 1995. The long-term Vermont trend is also significantly upward and steeper in trend than the US diabetes mortality.

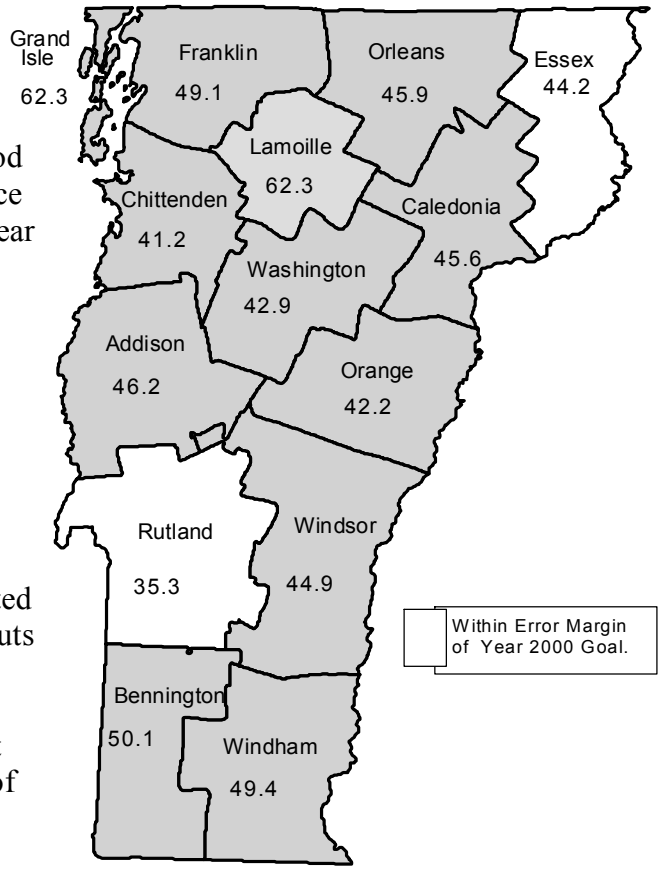


[4] 95% Confidence interval

Diabetes Mortality by County

Considering the county age-adjusted diabetes mortality, one sees that Rutland County, similar to Rutland health care area, has the lowest mortality over the five-year period 1993-97. Based on the interval of the confidence intervals, both Rutland and Essex Counties appear to be achieving the Year 2000 goal of an age adjusted mortality rate of 34 per 100,000 population. However, the large variability in the Essex estimate suggests that the Essex mortality rate may be as high as 63.5 per 100,000. Rutland County's mortality rate is statistically smaller than the statewide estimate. At the other extreme, Lamoille County, consistent with Copley HCA in the previous analysis, is unusually high at 62.3 diabetes related deaths per 100,000; and the confidence limits puts Lamoille far above the state average.

All other counties are not significantly different from the statewide age-adjusted mortality rate of 44.4 per 100,000 population.



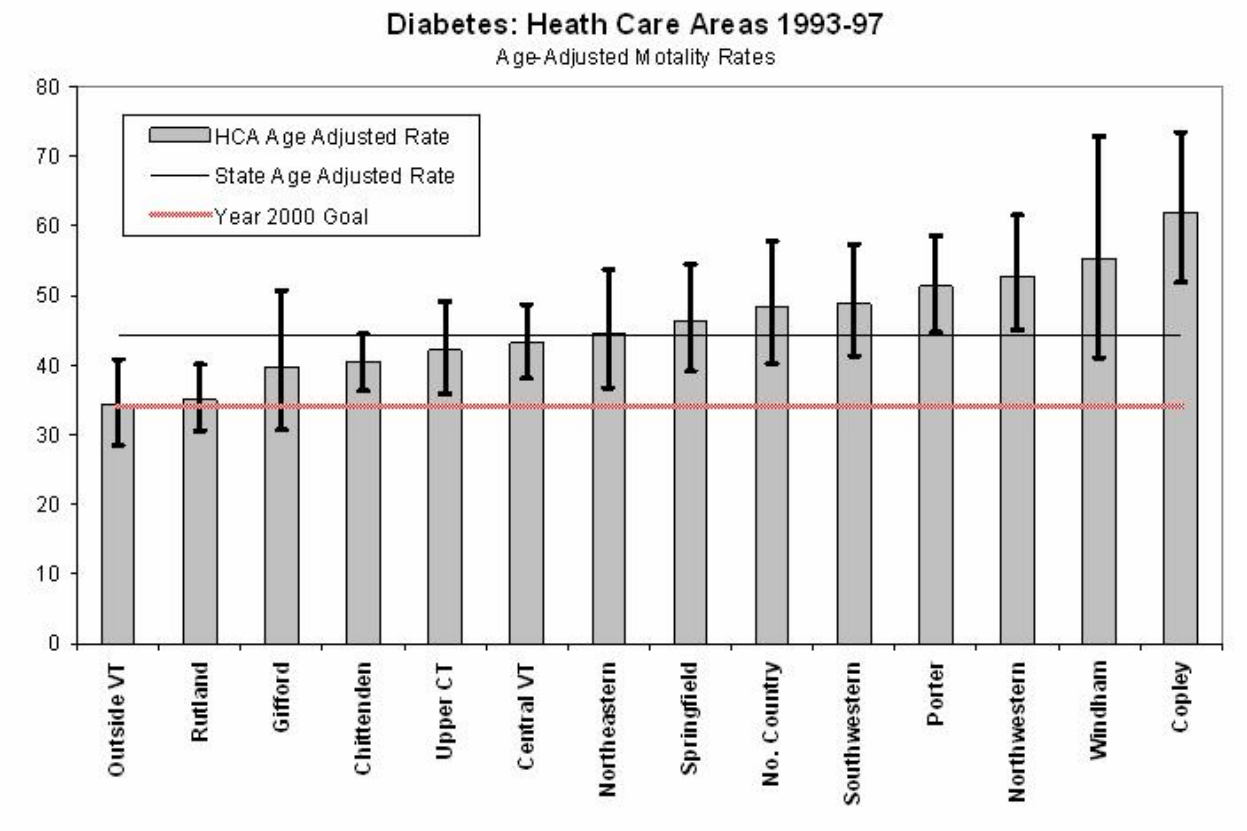
Again mortality differences may reflect differences in the way death certificates are completed, differences in ethnic composition, lifestyle differences, or some very real differences in health care practices.

1993-97 County	*Age Adjusted Rate*	*95% LCL*[5]	*95% UCL*
Essex	44.2	29.6	63.5
Rutland	35.3	30.8	40.4
Year 2000 Goal	**34.0**	**34.0**	**34.0**
Orange	42.2	34.6	51.0
Chittenden	41.4	37.4	45.7
Washington	42.9	37.6	48.8
Orleans	45.9	38.0	54.9
Caledonia	45.6	38.3	53.9
Addison	46.2	38.8	54.6
Windsor	44.9	39.5	50.7
Franklin	49.1	41.7	57.5
State	*44.4*	*42.6*	*46.2*
Grand Isle	62.3	42.6	87.9
Windham	49.4	42.9	56.6
Bennington	50.1	43.7	57.2
Lamoille	62.3	51.2	75.0

[5] 95% asymmetrical confidence interval computed using gamma function formula.

Diabetes Mortality by Health Care Area

When considered by health care area, two areas in Vermont appear to have achieved the Year 2000 goal of 34 deaths per 100,000, within the range of statistical fluctuation[6]. These are Rutland and Gifford.



Since these results depend on how the death certificate data are coded, one may suggest that these results reflect differences in how death certificates are completed by authorities in these regions. As indicated in the discussion on prevalence, typically one-third of the people with diabetes goes undiagnosed. So, a low prevalence of diabetes in these areas might indicate that diabetes is going undiagnosed at a higher rate than elsewhere. In which, case dispropor-tionately more diabetics in such areas would *not* be counted either in prevalence or in diabetes related mortality. However, there is no evidence that there are regional differences in observed prevalence. Statistically there are differences between the mortality rates, say, between Rutland and Copley HCA's. These differences suggest further investigation that might reveal processes beneficial to diabetics, or differences in service allocation.

[6] 95% asymmetrical confidence interval computed using gamma function formula.

Average Mortality Age of Diabetes

While people of all ages are at risk of either Type 1 or Type 2 Diabetes, death from diabetes affects people mostly in their senior years.

Because diabetes affects primarily older people, the average age of death from diabetes related causes is older than death due to other non-diabetes related causes. For the under 45 age group, average age of death from diabetes related causes is 10.9 years[7] older than non-diabetes related causes. For the 45 to 74 year old age group, the difference is 1.2 years older, while for the 75 and older group, those dying from diabetes related cause die on average 2 years younger than for non-diabetes related causes. This is not to say that the progression of diabetes in individuals is not severe, but the statistics indicates that those who do die of diabetes generally do so at a later age than those who die from other causes.

Sex	*Diabetes related*	*Not diabetes related*
Female	76.67	77.58
Male	72.62	69.08

While women generally die at an older age than do men[8], the difference is less so between men and women dying of diabetes related causes. If males die of a non-diabetes cause, they tend to do so at a younger age than if they were to die of a diabetes-related cause. The reverse is true for females; that is, females tend to die at a younger age due to diabetes related causes. Of those dying from non-diabetes causes, female die about eight and a half years older than males, while the difference is only four years for diabetes-related causes.

Age of Death	*Diabetes related*	*Not diabetes related*
Grand Isle	71.48	70.94
Rutland	72.09	73.55
Franklin	72.93	72.17
Essex	73.09	69.28
Chittenden	73.46	71.35
Windham	74.40	73.38
Windsor	74.55	74.24
Orleans	74.61	72.57
Lamoille	74.79	71.25
Washington	75.70	74.19
Orange	75.94	74.08
Caledonia	76.28	73.02
Addison	76.78	73.16
Bennington	76.96	75.87

In all counties of Vermont, except Rutland, the average age of death from diabetes-related causes is higher than for all other causes of death. A lower age of death reduces prevalence of diabetes, since it removes from the population those with this chronic disease. Prevalence is also affected by incidence, which is the number of new people diagnosed with the disease. Since it is generally a chronic disease without a cure, mortality will occur in the presence of the disease, but not necessarily as a result of diabetes being the underlying cause.

The age of death of course depends on many factors, but from death certificate data, one may examine the age of diabetes related death in the context of the major causes of death. For many causes of death, the age of death is older when diabetes is not mentioned on the death certificate. The table below considers, for Vermont residents, the major diseases that produce the most person-years of difference due to the difference in the age of death for person dying of a cause with and without mention of diabetes. For example, those dying due to a major cardiovascular disease during the period died at the average age of 78 if diabetes were not mentioned on the death certificate, but died at an average age of 74 if diabetes were mentioned as a contributing cause. On the other hand, those dying with diabetes listed as the underlying cause of death and a major cardiovascular disease listed as a contributing cause, did so at the average age of 73 years old. There are major causes of death where the reverse happens; e.g., malignant neoplasm,

[7] Based on 1993-97 mortality data.
[8] Mortality data from years 1993-1997

accidents and adverse effects. The largest age difference occurred for those dying with diabetes as the underlying cause and nephritis, nephrotic syndrome or nephrosis was listed as the contributing cause, when compared to those dying with nephritis, nephrotic syndrome or nephrosis as the underlying cause with no mention of diabetes. Also, those dying with diabetes as the underlying cause and pneumonia or influenza as the contributing cause, die nine years younger on average than others who die of pneumonia or influenza with no mention of diabetes.

1993-1997	*Diabetes Underlying*		*Diabetes Contributing*		*No Mention of Diabetes*	
	Count	Age	Count	Age	Count	Age
Malignant neoplasm	28	77	226	73	5,879	70
Septicemia	48	73	20	75	166	77
Major cardiovascular diseases	590	73	1,007	75	9,979	78
Heart disease - Goals 2000 definition	383	73	703	74	6,049	77
Pneumonia and influenza	48	74	67	81	911	83
Chronic obstructive pulmonary diseases	53	73	66	75	1,287	76
Chronic liver disease and cirrhosis	5	57	15	68	200	63
Nephritis, nephrotic syndrome and nephrosis	137	70	17	73	234	80
Accidents and adverse effects	23	70	25	77	969	52
All causes	695	73	1,632	75	23,622	74

Life Expectancy

Using life tables[9] one can estimate two aspects of life expectancy if a cause of death were hypothetically eliminated: these are the effects on the average life expectancy for

(1) *all* persons, and
(2) The group *dying of* the particular cause.

Life expectancy is the average number years lived past a particular age. By eliminating a cause, one estimates how much longer people would live on average. If diabetes were eliminated as the underlying cause of death, the overall life expectancy at birth would improve by 0.4 years; and for those dying of diabetes presently, 12.0 years of life on average would be added if diabetes were eliminated as a disease. The table below includes diabetes and several other causes of death for comparison purposes only. Notice in comparison 23.4 years could be added to the life expectancy of those dying of motor vehicle accidents. This reflects the age groups for which particular causes of disease affects life expectancy.

Age	*Diabetes*		*Motor Vehicle*		*Ischemic Heart Disease*		*Lung Cancer*	
	All	Dying of	All	Dying of	All	Dying of	All	Dying of
Birth	0.4	12.0	0.3	23.4	2.6	10.7	0.9	13.2
20	0.4	11.8	0.2	20.0	2.6	10.5	0.9	13.1
40	0.4	11.5	0.1	13.4	2.6	10.2	0.9	12.7
60	0.3	10.1	0.0	10.1	2.4	9.1	0.7	11.1
80	0.2	6.9	0.0	6.9	1.9	6.9	0.2	6.8

[9] Using mortality data for the years 1994-1996

Relationship of Other Causes of Death to Diabetes

Death certificates provide information on the underlying cause of death and additional information on the contributing causes. It is possible to examine the major causes of death as the underlying cause, and determine the percentage of deaths for which diabetes is listed as a contributing cause. For all causes of deaths for the years 1993-1997, 9.5 percent of the death certificates listed a diabetes code at least once as a contributing cause of death. Using the 72 major cause of death categories, the table below lists the 20 categories with the highest number of deaths, then sorted by the percent of death certificates with diabetes mentioned as a contributing cause. These categories are not mutually exclusive; that is, some may be subsets of others. The complete list is in the appendix.

Percent of Deaths with Diabetes Mentioned

Underlying Cause of Death	# Deaths	Percent
Chronic ischemic heart disease	2,403	12.7%
Ischemic heart disease	4,604	12.4%
Acute myocardial infarction	2,169	12.0%
Heart disease - year 2000 definition	6,049	11.6%
Diseases of heart	7,706	10.7%
Major cardiovascular diseases	9,983	10.1%
Other cerebrovascular diseases	1,247	9.6%
All causes of death	**24,569**	**9.5%**
Cerebrovascular disease	1,665	8.5%
All other forms of heart disease	2,519	7.9%
Pneumonia and influenza	915	7.3%
Pneumonia	890	7.3%
Other chronic obstructive pulmonary diseases	1,083	5.5%
Chronic obstructive pulmonary diseases	1,288	5.1%
Malignant neoplasm: of digestive organs and peritoneum	1,307	4.7%
Malignant neoplasm: genital organs	735	4.2%
Malignant neoplasm: of respiratory and intrathoracic organs	1,620	4.1%
Malignant neoplasm (all)	5,879	3.8%
All other accidents (excludes motor vehicle)	557	3.8%
Accidents and adverse effects	975	2.6%
Malignant neoplasm: other and unspecified sites	788	1.9%

Appendix

Rank	Percent mortality with diabetes mentioned Underlying cause of death	#Deaths	#Diabetes	Percent
58	Shigellosis and amebiasis	1	0	0.0%
15	Certain other intestinal infections	10	1	10.0%
58	Tuberculosis	7	0	0.0%
58	Tuberculosis of respiratory system	7	0	0.0%
58	Other tuberculosis	0	0	0.0%
58	Whooping cough	0	0	0.0%
58	Streptococcal sore throat & scarlatina	0	0	0.0%
58	Meningococcal infection	2	0	0.0%
9	Septicemia	168	20	11.9%
58	Acute poliomyelitis	0	0	0.0%
58	Measles	0	0	0.0%
24	Viral hepatitis	24	2	8.3%
58	Human immunodeficiency virus	13	0	0.0%
58	Syphilis	0	0	0.0%
52	All other infectious and parasitic diseases	186	4	2.2%
45	Malignant neoplasms	5,879	226	3.8%
58	Of lip, oral cavity and pharynx	80	0	0.0%
40	Of digestive organs and peritoneum	1,307	62	4.7%
44	Of respiratory and intrathoracic organs	1,620	66	4.1%
48	Of breast	470	15	3.2%
41	Of genital organs	735	31	4.2%
37	Of urinary organs	280	15	5.4%
54	Of other and unspecified sites	788	15	1.9%
42	Leukemia	219	9	4.1%
47	Leukemia of other lymphatic/hematopoietic tissues	380	13	3.4%
49	Benign neoplasms	102	3	2.9%
16	Nutritional deficiencies	30	3	10.0%
53	Anemias	47	1	2.1%
58	Meningitis	4	0	0.0%
14	Major cardiovascular diseases	9,983	1,007	10.1%
11	Diseases of heart	7,706	825	10.7%
31	Rheumatic fever and heart disease	69	5	7.2%
22	Hypertensive heart disease	237	21	8.9%
1	Hypertens heart and renal disease	19	5	26.3%
7	Ischemic heart disease	4,604	569	12.4%
8	Acute myocardial infarction	2,169	260	12.0%
4	Other acute and subacute forms	11	2	18.2%
5	Angina pectoris	21	3	14.3%
6	Chronic ischemic heart disease	2,403	304	12.7%
13	Other diseases of endocardium	258	27	10.5%
26	All other forms of heart disease	2,519	198	7.9%
12	Hypertension	113	12	10.6%
10	Heart disease - year 2000 definition	6,049	703	11.6%
23	Cerebrovascular disease	1,665	142	8.5%
36	Intracranial hemorrhage	218	12	5.5%
39	Cerebral thrombosis and occlus.	196	10	5.1%
58	Cerebral embolism	4	0	0.0%

Rank	Percent mortality with diabetes mentioned Underlying cause of death	#Deaths	#Diabetes	Percent
18	Other cerebrovascular diseases	1,247	120	9.6%
17	Atherosclerosis	133	13	9.8%
43	Other diseases of arteries	366	15	4.1%
58	Acute bronchitis	4	0	0.0%
29	Pneumonia and influenza	915	67	7.3%
30	Pneumonia	890	65	7.3%
25	Influenza	25	2	8.0%
38	Chronic obstructive pulmonary diseases	1,288	66	5.1%
20	Bronchitis	43	4	9.3%
57	Emphysema	127	1	0.8%
50	Asthma	35	1	2.9%
35	Other chr. Obstr. Pulmonary dis.	1,083	60	5.5%
33	Ulcer of stomach and duodenum	58	4	6.9%
3	Appendicitis	4	1	25.0%
34	Hernia and intestinal obstruction	67	4	6.0%
28	Chronic liver disease and cirrhosis	200	15	7.5%
21	Gallbladder disorders	33	3	9.1%
32	Nephritis, nephrotic syndrome and nephrosis	235	17	7.2%
58	Acute glomerulonephritis	3	0	0.0%
58	Chronic glomerulonephritis	14	0	0.0%
27	Renal failure	218	17	7.8%
2	Infections of kidney	12	3	25.0%
58	Hyperplasia of prostrate	9	0	0.0%
58	Complications of pregnancy and childbirth	2	0	0.0%
58	Pregnancy with abortive outcome	1	0	0.0%
58	Other complications	1	0	0.0%
58	Congenital anomalies	128	0	0.0%
58	Certain perinatal conditions	106	0	0.0%
58	Birth trauma	17	0	0.0%
58	Other perinatal conditions	89	0	0.0%
58	Symptoms, signs and ill-defined conditions	117	0	0.0%
51	Accidents and adverse effects	975	25	2.6%
56	Motor vehicle accidents	418	4	1.0%
46	All other accidents	557	21	3.8%
55	Suicide	368	4	1.1%
58	Homicide and legal intervention	51	0	0.0%
58	All other external causes	52	0	0.0%
19	All causes of death	24,569	2,345	9.5%