

# Diabetes Mortality in Colorado 1994-1998

## Summary of Findings

Diabetes continues to be the eighth leading underlying cause of death in Colorado. Diabetes was reported as the underlying or contributory cause for 9,005 deaths of Colorado residents between 1994 and 1998, with a yearly average of 1,801 deaths. The average age-adjusted death rate from diabetes as the underlying cause (listed as the immediate cause on the death certificate) in Colorado for the period 1994 to 1998 was 14.8 per 100,000 population. However, when diabetes-related deaths (diabetes listed as a cause of death, but not the primary cause) were included, the age-adjusted mortality averaged 50.8 per 100,000 population. This rate has increased over the past 10 years from 46.6 to 52.1 per 100,000 population.

While still above the desirable limit, Colorado's overall age-adjusted rate of diabetes-related deaths remains lower than that of the nation. In 1996, the most recent year for which national diabetes-related death rates are available, Colorado's rate was 52.0 per 100,000 population, compared to the U.S. rate of 64.0 per 100,000 population<sup>1</sup>. However, among African-American males, the age-adjusted rate of diabetes-related deaths was 116.0 per 100,000 in Colorado, while the U.S. rate was 114.2 per 100,000. Moreover, African-American men die at significantly lower ages than their non-Hispanic and Hispanic counterparts. Colorado Hispanics showed a higher rate for diabetes-related mortality than African-Americans and non-Hispanic whites, in three out of the five years.

Death rates also vary by geographic region. Four counties (Adams, Denver, Otero, and Pueblo) had age-adjusted diabetes-related death rates significantly higher than the overall state rate of 50.8 per 100,000 population, while six counties (Boulder, Jefferson, Park, Pitkin, Routt, and Summit) had significantly lower diabetes-related death rates than the overall state rate. As a region, the Eastern Plains are found to have a significantly higher diabetes-related mortality rate than the state rate.

The *Healthy People 2000* goal is to have an age-adjusted mortality rate related to diabetes of no more than 41.7 deaths per 100,000 population. Unfortunately, the trend since 1989 in Colorado has been moving away from this goal.

## Data Sources and Limitations

This report on diabetes-related mortality in the state of Colorado uses death certificate data to identify deaths that have diabetes listed as an underlying or contributory cause of death. Although this may not represent all individuals with diabetes who have died in the state, it does give some indications as to the scope of diabetes-related deaths. Investigation of this information includes analysis of demographic characteristics, trends, and mortality by geographic residence.

The Health Statistics and Vital Records Division of the Colorado Department of Public Health and Environment provided the 1994 through 1998 death certificate data for this report. This is a follow-up report to *Diabetes Mortality in Colorado Residents as Assessed from Death Certificate Data 1989-1993*<sup>2</sup>. Where applicable, data for the ten-year period (1989-1998) were used. For this report, age-adjusted mortality rates were calculated using the direct method and the 1980 U.S. population as a standard. A normal approximation was used to calculate confidence limits for these rates<sup>7</sup>. The Demographic Section of the Colorado Department of Local Affairs provided population data for this report.

The underlying cause of death, and up to eleven contributory causes, were coded for each death certificate. A diabetes-related death was defined as any death with an underlying and/or contributory

cause recorded as diabetes (see Appendix for diabetes codes 250.X of the *International Classification of Diseases, Version Nine* or ICD-9).

The World Health Organization defines the underlying cause of death as the disease or injury that initiated the chain of morbid events leading directly to death, or as the circumstances of the accident or violence that produced the fatal injury. Other causes recorded on the death certificate are the immediate cause of death, the antecedent cause (giving rise to the immediate cause), and other significant conditions contributing to the death. These additional causes provide further information on the impact of diabetes.

In an earlier report, *Diabetes Mortality in Colorado Residents as Assessed from Death Certificate Data: 1979-1988*<sup>3</sup>, the Hispanic group was defined as white race and Spanish surname. Changes made to the death certificate form in 1989 have provided a checkbox for Hispanic origin. Therefore, in the 1989-1993 report and in this report, the Hispanic ethnic group was defined as white race and Hispanic origin as indicated on the death certificate. This change represents an improvement in diabetic mortality statistics with more individuals having been clearly identified in the Hispanic ethnic group. The African-American sub-group continues to represent both Hispanic and non-Hispanic African-Americans due to the small number of such occurrences.

Other disease categories mentioned in this report were defined with the following ICD-9 classifications: 1) Heart disease, 390-398, 402, 404-429; 2) malignant neoplasms, 140-208; 3) cerebrovascular disease, 430-438; 4) influenza and pneumonia, 480-487; and 5) chronic obstructive pulmonary disease, 490-496.

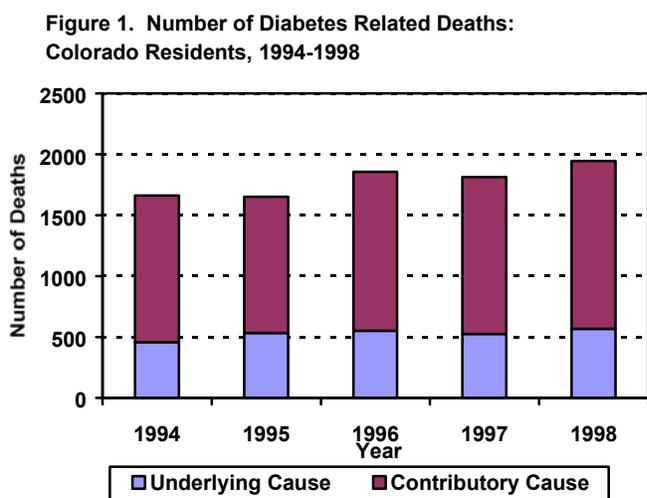
The national age-adjusted death rate, with diabetes as an underlying cause, remained relatively constant during the 1980's. However, in 1989, a new standard death certificate was implemented in the United States. By 1994, the age-adjusted diabetes death rate was 27 percent higher than in 1980 (19.5 per 100,000 vs. 15.3 per 100,000 respectively)<sup>4</sup>. In Colorado, some changes were made in the death certificates. However, the changes that may have affected diabetes reporting nationally, were not made on the Colorado Certificate of Death.

Colorado based diabetes prevalence estimates are available through the Colorado Behavioral Risk Factor Surveillance System (BRFSS). These estimates range from 2.5 percent to 2.6 percent of the population during the years 1991 through 1994<sup>5,6</sup>. However, the number of individuals with diabetes interviewed each year is small, and several years of data must be aggregated to obtain accurate estimates<sup>5</sup>. Additionally, the numbers are too small to estimate county or racial/ethnic specific prevalence. Therefore, national rates of diabetes were used to estimate the number of individuals in Colorado with diabetes. Geographic variations in death rates based on the estimated prevalence of diabetes should be viewed with caution until further investigation is done in each area. These variations may result from natural fluctuations occurring in small populations or they may be caused by other factors not analyzed in this report.

## **Results**

### **Number of Diabetes-Related Deaths**

From 1994 to 1998, 9,005 diabetes-related deaths were identified among Colorado residents, for a yearly average of 1,801 deaths. Figure 1 shows

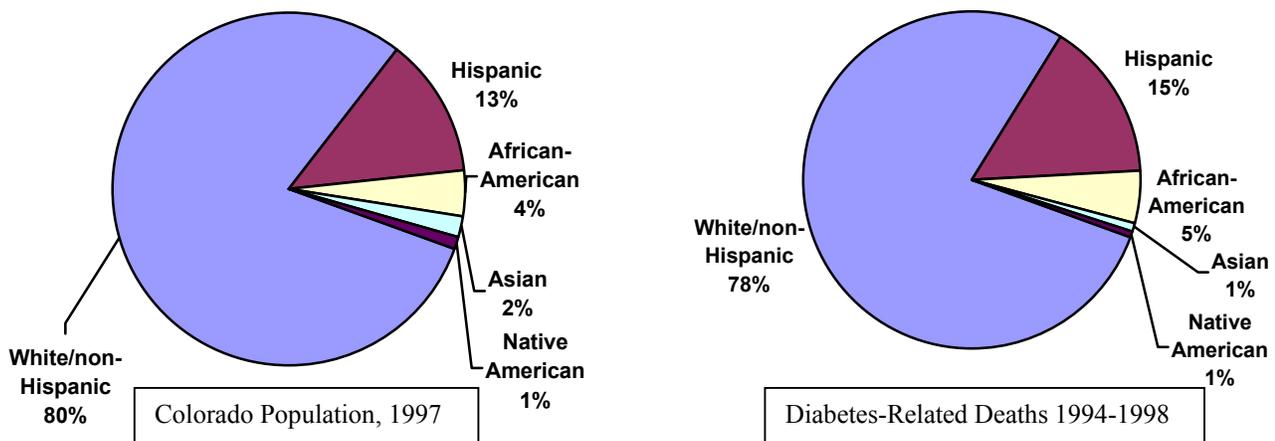


that the lowest number of diabetes-related deaths was 1,661 in 1994 and increased to a high of 1,944 deaths in 1998 (see Table 1). In comparing the increasing trend in Colorado to that demonstrated in the national mortality data from the Centers for Disease Control and Prevention, a local increase of 34 percent was observed, while a national increase of 20 percent was observed between 1989 and 1996<sup>1</sup> (the most recent year that national data are available).

This information can be helpful in identifying the breadth of diabetes in Colorado. However, the increase in the number of deaths from 1994 to 1998 should be viewed in relationship to changes in the population and its characteristics. Colorado's population increased an estimated 9.9 percent over this time period<sup>7</sup>. In comparison, the number of diabetes-related deaths rose 17 percent.

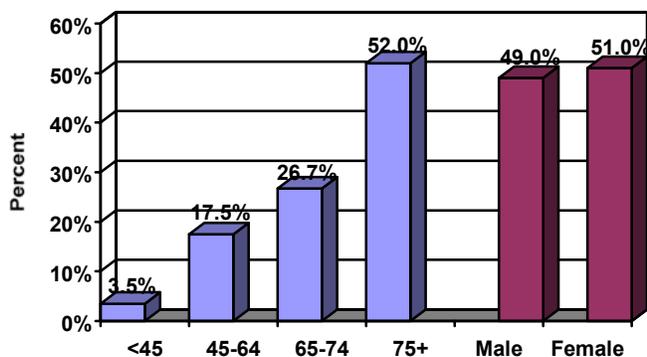
The 1997 population of Colorado was comprised of 79.8 percent white/non-Hispanics, 12.9 percent Hispanics, four percent African-American, two percent Asian, and one percent American Indian<sup>7</sup>. In contrast, the distribution of the diabetes-related deaths by race/ethnicity is depicted in Figure 2 and Table 2.

**Figure 2. Race/Ethnicity Distribution of Colorado, 1997 vs. Diabetes-Related Deaths by Race/Ethnicity: 1994-1998**



The distribution of diabetes-related deaths mirrors the demographic distribution of Colorado, with the exception of the Hispanic population. The Hispanic population in Colorado has increased by 26 percent from 1990 to 1997<sup>7</sup>. Hispanics have had a higher diabetes-related death rate, which when coupled with the growth in population contributes to the increase in the number of diabetes-related deaths in Colorado.

**Figure 3. Percent of Diabetes-Related Deaths by Age and Gender: Colorado Residents 1994-1998**

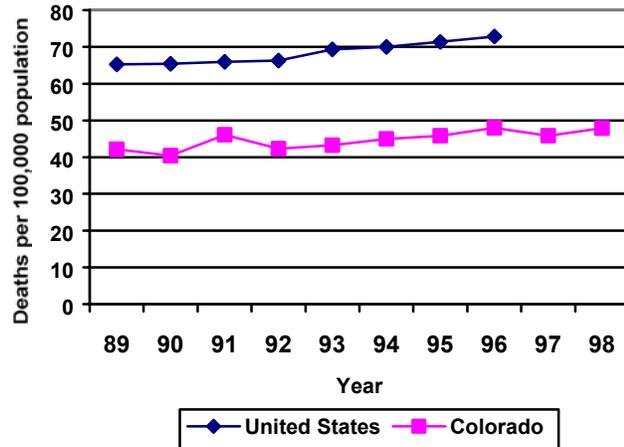


The age and gender distributions of the 9,005 diabetes-related deaths from 1994 to 1998 are depicted in Figure 3. Twenty-one percent of the deaths occurred in persons aged 64 or younger, while 52 percent of the deaths occurred in persons over age 75. Males comprised a slightly smaller percent of the deaths than females (Table 3).

## Crude Mortality Rates

The annual crude mortality rate for diabetes-related deaths among Colorado residents has continued to increase over the past ten years from 42.1 per 100,000 to 47.9 per 100,000. The Colorado rates for 1989 through 1998 and the United States rates<sup>7</sup> for 1989 through 1996 are illustrated in Figure 4. The lower level of the Colorado crude mortality rate may be partially attributed to Colorado's younger population (Tables 4 and 5).

Figure 4. Crude Diabetes-Related Mortality Rates: Colorado Residents and United States, 1989-1998

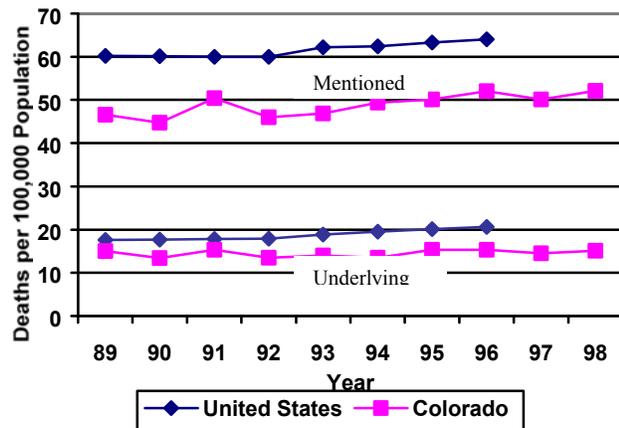


## Age-Adjusted Mortality Rates for Colorado and the United States

The age-adjustment procedure takes into account the differences in age distribution of populations and yields a better measure for comparisons than crude mortality rates. The age-adjusted rate for all diabetes-related mortality (any mention of diabetes on the death certificate) remained relatively stable for this five-year period. This also held true when stratified by gender and by the major racial/ethnic groups (Table 6). However, for the ten-year period from 1989 through 1998, there was a very small increase in the age-adjusted diabetes-related mortality rate as well as the age-adjusted rate for diabetes as an underlying cause. Colorado men had a consistently higher diabetes related mortality rate than women in all study years. In fact this difference seems to be getting more evident in recent years.

Figure 5 presents the age-adjusted diabetes-related mortality rates for Colorado and the United States adjusted to the 1980 U.S. population. In 1996, the age-adjusted Colorado mortality rate for diabetes as the underlying cause was 15.3 per 100,000 population. The U.S. rate for the same year was 20.6. For diabetes listed as any cause, the Colorado rate for 1996 was 52.0 per 100,000 and the U.S. rate was 64.0 per 100,000<sup>7</sup>. The Colorado rates have been consistently lower than those for the nation since 1989 (Tables 4 and 5).

Figure 5. Age-Adjusted Diabetes-Related Mortality Rates, Underlying and Mentioned Causes: Colorado Residents and United States, 1989-1994

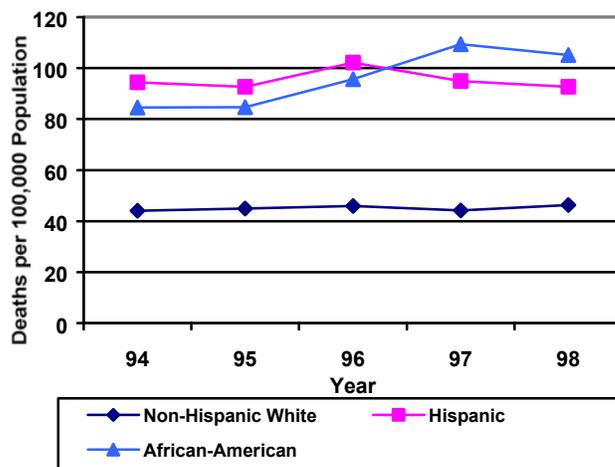


\* Adjusted to the 1980 U.S. population

## Differences in Mortality Rates by Race/Ethnicity

Nationally, the age-adjusted rate for diabetes-related mortality is higher for African-Americans than non-Hispanic whites and Hispanics<sup>1</sup>. However, Colorado Hispanics showed a higher rate for diabetes-related mortality in three out of the five years (Figure 6). No significant difference was found between African-American and Hispanic rates (Table 6). Non-Hispanic whites, Hispanics, and African-Americans comprise over 98 percent of the diabetes-related deaths in Colorado over this five-year period (for the number of deaths by racial/ethnic group, see Table 2).

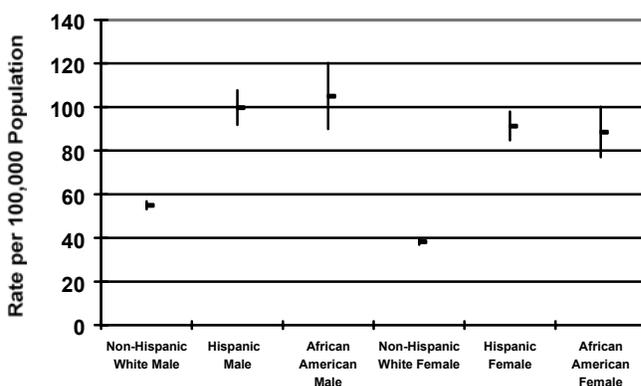
**Figure 6. Age-Adjusted Diabetes-Related Mortality Rates by Race/Ethnicity: Colorado Residents, 1994-1998**



\* Adjusted to the 1980 U.S. population

U.S. age-adjusted mortality rates were 68.0 per 100,000 for non-Hispanic white males and 51.5 per 100,000 for non-Hispanic white females in 1996, the most recent year for which U.S. data are available. The rate for Hispanic males was 80.2 per 100,000, while that for females was 68.3 per 100,000. Among African-Americans in the U.S., these rates were 111.0 per 100,000 males and 108.9 per 100,000 females<sup>1</sup>. In comparison, the Colorado age-adjusted rates for non-Hispanic whites for the same year were 54.0 per 100,000 males and 40.3 for females, and Hispanics were 110.4 per 100,000 males and 95.0 per 100,000 females. Colorado rates for African-American males were 116.0 per 100,000 and African-American females were 81.7 for the same year.

**Figure 7. Average Age-Adjusted Diabetes-Related Mortality Rates by Race/Ethnicity and Gender: Colorado Residents 1994-1998**



\* Age-adjusted to the 1980 U.S. population including 95 percent confidence limits

Using the more detailed Colorado ethnicity data available from 1994 through 1998, Figure 7 shows gender specific, age-adjusted diabetes-related five-year mortality rates for non-Hispanic whites, Hispanics and African-Americans. Included are the 95 percent confidence limits around the age-adjusted rates.

In Colorado, non-Hispanic whites had significantly lower rates than either African-American or Hispanic groups, with non-Hispanic white females experiencing the lowest rates. From 1994 to 1998, non-Hispanic white females had an average age-adjusted rate for diabetes-related mortality of 38.1 per 100,000 population. Non-Hispanic white males had a rate of 54.9 per 100,000.

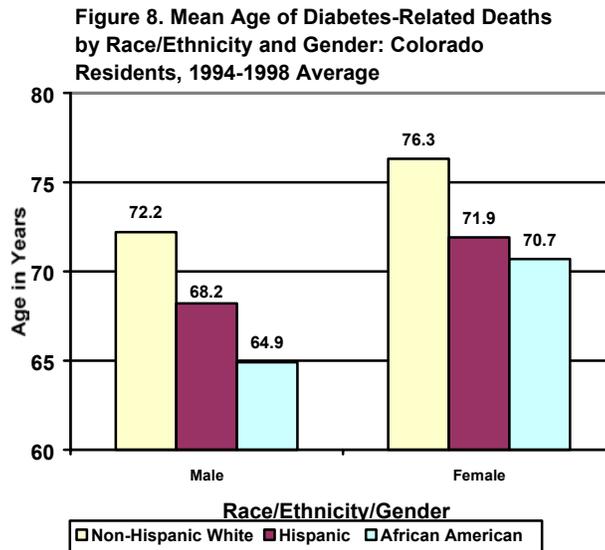
The annual average age-adjusted diabetes mortality rates for African-American males, African-American females, Hispanic males, and Hispanic females are not significantly different. Confidence limits for

African-American males and females are especially large due to the smaller number of African-American residents in Colorado.

### Mean Age at Death for Diabetes-Related Deaths by Gender and Race/Ethnicity

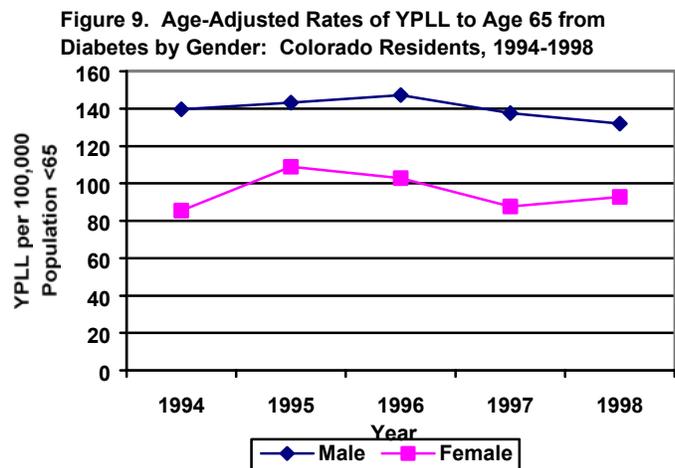
From 1994 to 1998, the mean age at death for Coloradans with diabetes was 73.3 years of age. Males had a slightly lower mean age of death than females (71.2 years and 75.2 years respectively), with this difference being statistically significant (Table 7).

The average age at death (diabetes-related) for non-Hispanic whites was 74.3 years, for Hispanics was 70.2 years, and for African-Americans was 67.9 years. The differences between these racial/ethnic groups were found to be statistically significant. The mean age at death, by gender, for selected racial/ethnic groups is reported in Figure 8. In each racial/ethnic group, the mean age at death for females is significantly higher than that for males. Although the age at death of non-Hispanic white females with diabetes is significantly higher than the age at death of Hispanic and African-American females, there is no significant difference in age at death between Hispanic and African-American females. For males, the differences between each of these racial/ethnic groups were found to be statistically significant.



### Years of Potential Life Lost (YPLL)

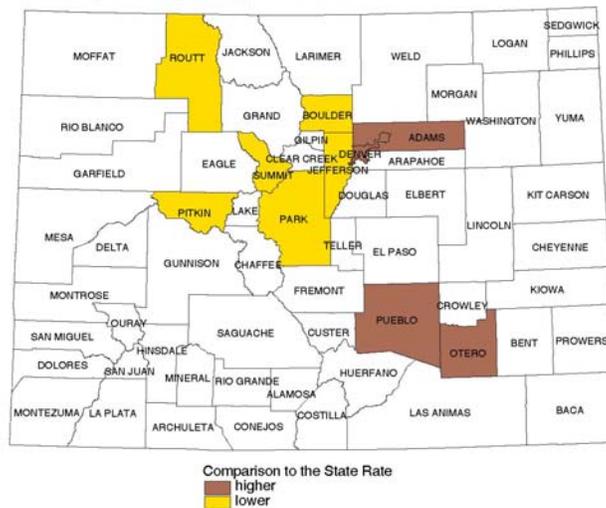
Overall, diabetes removed about 112 to 126 years of productive life to age 65 for every 100,000 Colorado residents per year. Premature mortality is emphasized using indices of years of potential life lost (YPLL). Figure 9 shows the YPLL to age 65 from diabetes by gender. Males lost a greater number of years of productive life to age 65 than females because of higher mortality rates early in life (Table 8).



## Geographic Variation in Mortality

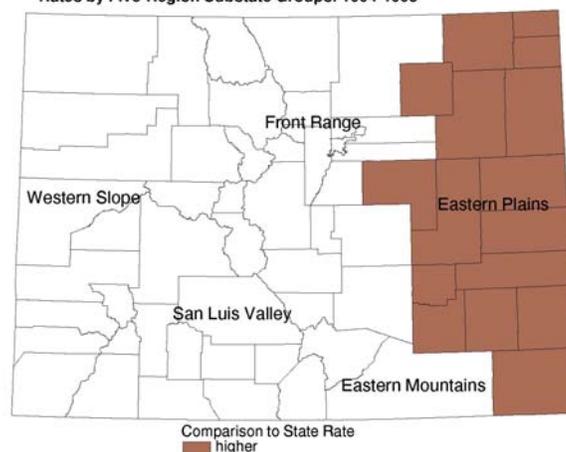
County specific diabetes-related mortality in Colorado residents for the time period 1994 to 1998 is represented in Map 1. The information is presented to identify counties in which the diabetes-related mortality is either significantly above or below that of the state. Counties with 95 percent confidence limits, which do not overlap state confidence limits, have mortality rates statistically higher or lower than that for the state as a whole. Four counties had mortality rates above the state rate: Adams, Denver, Otero, and Pueblo. Six counties had mortality rates lower than the state rate: Boulder, Jefferson, Park, Pitkin, Routt, and Summit. Tables 9 and 10 list diabetes-related mortality rates for each county and region.

**Map1: Average Age-Adjusted Diabetes-Related Mortality Rates by County: 1994-1998**



When looking at the state by the five geographic regions (Front Range, Western Slope, Eastern Plains, San Luis Valley, and Eastern Mountains), the Eastern Plains are found to have a significantly higher diabetes-related mortality rate than the state rate. Individually, the counties may not exhibit a significantly higher rate because of their small sample sizes (which causes a large confidence interval). However, when looking at the combined data for these counties, the sample size is large enough to observe a significant difference.

**Map 2: Age-Adjusted Diabetes Mortality Rates by Five-Region Substate Groups: 1994-1998**



## Most Common Underlying Cause of Death in Persons with Diabetes

Diabetes was selected as the underlying cause of death for 29.3 percent of the 9,005 diabetes-related deaths between 1994 and 1998. Heart disease was the most common underlying cause (32.8 percent), followed by diabetes mellitus (29.3 percent), malignant neoplasms (9.0 percent), cerebrovascular disease (6.4 percent), COPD (3.5 percent), diseases of the digestive system (3.5 percent), and influenza and pneumonia (2.7 percent) (Figure 10). All other underlying causes represented over 13 percent of all diabetes-related deaths (Table 11). The proportions of deaths attributable to these disease classifications were similar each year during this period, as was true in the previous ten-year period, when heart disease and diabetes were the top two underlying causes of death each year in persons with diabetes<sup>2,3</sup>.

There were 2,636 deaths with diabetes as the underlying cause in Colorado residents between 1994 and 1998. Over 13 percent of these individuals died from an underlying cause of diabetes with coma, and almost 7 percent died from diabetes with other neurological manifestations. Another 5.4 percent died from ketoacidosis or hyperosmolar coma, which has declined from previous publications reporting 5.4 percent for 1989-1993 and 8.9 percent for 1979-1988<sup>3</sup> (Table 12).

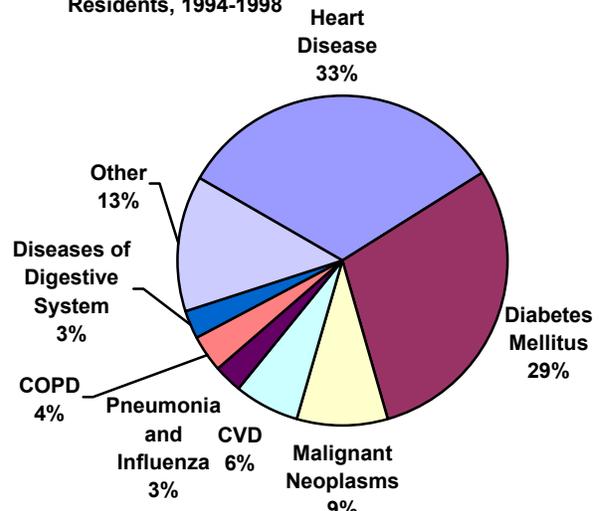
## Discussion

Colorado's standing in terms of the magnitude of death from diabetes continues to be better than that of the nation as a whole. Heart disease remains the number one listed underlying cause of death for individuals with any mention of diabetes on their death certificates. An encouraging sign is a decrease in the proportion of deaths attributed to the potentially preventable complications of ketoacidosis and hyperosmolar coma, although this is unchanged from the 1989-1993 value.

Unfortunately, the overall rate of age-adjusted diabetes-related deaths has shown a slight increase over the last fifteen years. This increase is quite small, and it occurs at a time when one might expect to see a decline in the death rate due to advances in knowledge and availability of new treatments and technologies. However, the treatment of hypertension and coronary heart disease has improved, and more patients live long enough to develop diabetes and the complications associated with diabetes, thus increasing the likelihood for diabetes to appear as a cause of death on the death certificate.

The diabetes-related death rate remains higher for males than for females. African-Americans and Hispanics continue to have diabetes-related mortality rates almost double (96.3 and 95.3 respectively) those of non-Hispanic whites (45.1). According to the Centers for Disease Control and Prevention's National Center for Health Statistics, death certificates listed diabetes as the fifth leading cause of death for African-Americans aged 45 to 64, and the third leading cause of death for those aged 65 and older in 1993<sup>9</sup>. Nationally, all major racial and ethnic groups have a high prevalence of diabetes, but African-Americans and Hispanics are disproportionately affected (almost twice as likely to have diabetes as non-Hispanic whites of similar age). This contributes to the higher diabetes-related death rates in these

Figure 10. Percentage of Underlying Causes of Death in Persons with Diabetes: Colorado Residents, 1994-1998



groups<sup>8</sup>. Obesity is a major risk factor for Type 2 diabetes, and African-Americans and Hispanics are more likely than non-Hispanic whites to be overweight<sup>9,10</sup>. Compared to non-Hispanic whites, African-Americans and Hispanics experience higher rates of complications related to diabetes and a greater degree of disability from these complications. Some factors that influence the frequency of these complications include delay in diagnosis, denial of diabetes, abnormal blood lipids, high blood pressure, and cigarette smoking<sup>9,10</sup>. Proper diabetes management can prevent African-Americans and Hispanics from dying at a younger age than their non-Hispanic white counterparts.

Clearly, there is much work to be done if Colorado is to reach its target of reducing the diabetes-related death rate. It is hoped that the information contained in this report will be helpful in the planning and implementation of activities that can assist Colorado in reaching that goal.

## **References**

1. U.S. Department of Health and Human Services. Centers for Disease Control and Prevention. The Division of Diabetes Translation. *Diabetes Surveillance*. 1999.
2. Colorado Department of Public Health and Environment. Health Statistics Section/Chronic Disease Section. *Diabetes Mortality in Colorado Residents as Assessed from Death Certificate Data 1989-1993*. 1996.
3. Colorado Department of Public Health and Environment. Health Statistics Section/Chronic Disease Section. *Diabetes Mortality in Colorado Residents as Assessed from Death Certificate Data 1979-1988*. 1991.
4. U.S. Department of Health and Human Services. Centers for Disease Control and Prevention. The Division of Diabetes Translation. *Diabetes Surveillance*. 1997.
5. Colorado Department of Public Health and Environment. Health Statistics Section/Chronic Disease Section. *Diabetes Prevalence and Risk Factors: Colorado Behavioral Risk Factor Surveillance System, 1990-1994*. 1996.
6. Colorado Department of Public Health and Environment. Health Statistics Section. *Colorado Vital Statistics, 1994*. 1996.
7. Colorado Department of Public Health and Environment. Health Statistics Section. *Colorado Vital Statistics, 1997*. 1999.
8. Safran, M, Vinicor, F: The War Against Diabetes: How will we know if we are winning? *Diabetes Care* 22: 508-516, 1999.
9. National Institute of Diabetes and Digestive and Kidney Diseases. (1997). *Diabetes in African-Americans* (NIH Publication No. 97-3266). Bethesda, MD: National Institutes of Health.
10. National Institute of Diabetes and Digestive and Kidney Diseases. (1997). *Diabetes in Hispanic-Americans* (NIH Publication No. 97-3266). Bethesda, MD: National Institutes of Health.

