

Montana Deaths Caused by Diabetes

Introduction

Diabetes is a chronic medical condition that affects 1 in 10 adults in Montana (MT).¹ Diabetes impacts multiple organs and can lead to serious health complications and death.² Diabetes mortality differs by age and type of diabetes.

In children and young adults, the two most life-threatening diabetes complications are diabetic ketoacidosis (DKA) and hypoglycemic coma. DKA results from lack of insulin. DKA can be the first sign of type 1 diabetes in a previously undiagnosed person. It can also occur in people with type 1 diabetes when insulin requirements rise during medical psychological stress. Insufficient insulin administration is another common cause of DKA. DKA accounts for 50% of all deaths in children and young adults aged less than 24 years with type 1 diabetes.^{3,4} Deaths attributed to severe hypoglycemia and coma in young individuals with type 1 diabetes has substantially decreased in the last decade, mostly due to diabetes-related technology and pharmacotherapy.⁵

Hyperosmolar nonketotic coma is a complication of diabetes (mostly type 2 diabetes) when the disease is uncontrolled. It occurs when high blood sugars cause severe dehydration and increases the risk of complications, coma or death.

In older individuals, diabetes-related death generally is caused by cardiovascular disease, kidney disease or other chronic progressive complications.⁶

Understanding and estimating mortality in people with diabetes is complicated. The physician completing the death certificate can list one underlying (leading) cause of death and up to 20 other contributing multiple causes. Research shows that about 35%-40% of decedents with diabetes had "diabetes" listed anywhere on the death certificate and about 10%-15% had it listed as the underlying cause of death.⁷ Thus, diabetes is likely to be underreported as a contributing cause of death.

This surveillance report summarizes diabetes deaths that occurred in MT among residents from 1999 through 2015. A focus was placed on diabetes deaths among children 1 through 17 years and young adults aged 18 through 29 years. Because deaths from DKA and hypoglycemia could be preventable, we reviewed circumstances of death in young adults where diabetes was listed as an underlying or contributing cause of death to identify high risk situations for young people with diabetes.

To address other diabetes-related causes of death that can be avoided or delayed through lifestyle changes and diabetes self-management, additional prevention strategies are provided as recommendations for clinicians and educators at the end of this report.

Report Highlights

- **An estimated 63,000** Montana adults had diabetes in 2015
- **Over 12,000** Montana deaths were attributed to diabetes since 1999
- Overall the **risk of death among people with diabetes is twice** that of people of similar age without diabetes.

Upcoming Events

20th Montana Diabetes Professional Conference -
October 5-6, Bozeman, MT

Montana Diabetes Program

1400 E Broadway

Helena, Montana 59260-2951

<https://dphhs.mt.gov/publichealth/Diabetes>

Methods

Death records were used to identify MT residents aged one year and older who died in MT in the last 17 years (1999-2015). We flagged all records with underlying and contributing causes (total of 21 fields) that contained ICD-10 diabetes codes E10-E14. To conduct more in-depth analysis we coded diabetes deaths into following categories:

- Acute metabolic deaths for hypoglycemia or ketoacidosis (E10.0, E10.1, E11.0, E11.1, E12.0, E12.1, E13.0, E13.1, E14.0, E14.1, E15, E16.0-E16.2)
- Type 1 diabetes (E10.0-E10.9)
- Type 2 diabetes (E11.0-E11.9)
- Malnutrition-related diabetes (E12.0-E12.9)
- Other Specific diabetes (E13.0-13.9)
- Unspecified diabetes (E14.0-E14.9)

Records where diabetes was flagged as a contributing cause to death were classified by their underlying cause, time and place of death, as well as other co-morbid conditions and demographic variables. Non-diabetes leading causes of death were classified into the following categories based on ICD-10 codes:

- Diseases of heart (I00-I09, I11, I13, I20-I51)
- Malignant neoplasms (cancer) (C00-C97)
- Chronic lower respiratory diseases (J40-J47)
- Accidents (unintentional injuries) (V01-X59, Y85-Y86)

Population estimates for MT age-specific groups were obtained from the National Center for Health Statistics, 1999-2015. Diabetes prevalence estimated for population aged 18 years the Behavioral Risk Factor Surveillance Survey.

An age-specific mortality rate is a crude death rate for a specific age group.

An age-adjusted mortality rate was calculated to better illustrate indicators than unadjusted (crude) death rates. This calculation method illustrates changes in the risk of death over the years when the age distribution of the population is changing.

Underlying cause of death is the disease or injury that started the sequence of events resulting directly in death.

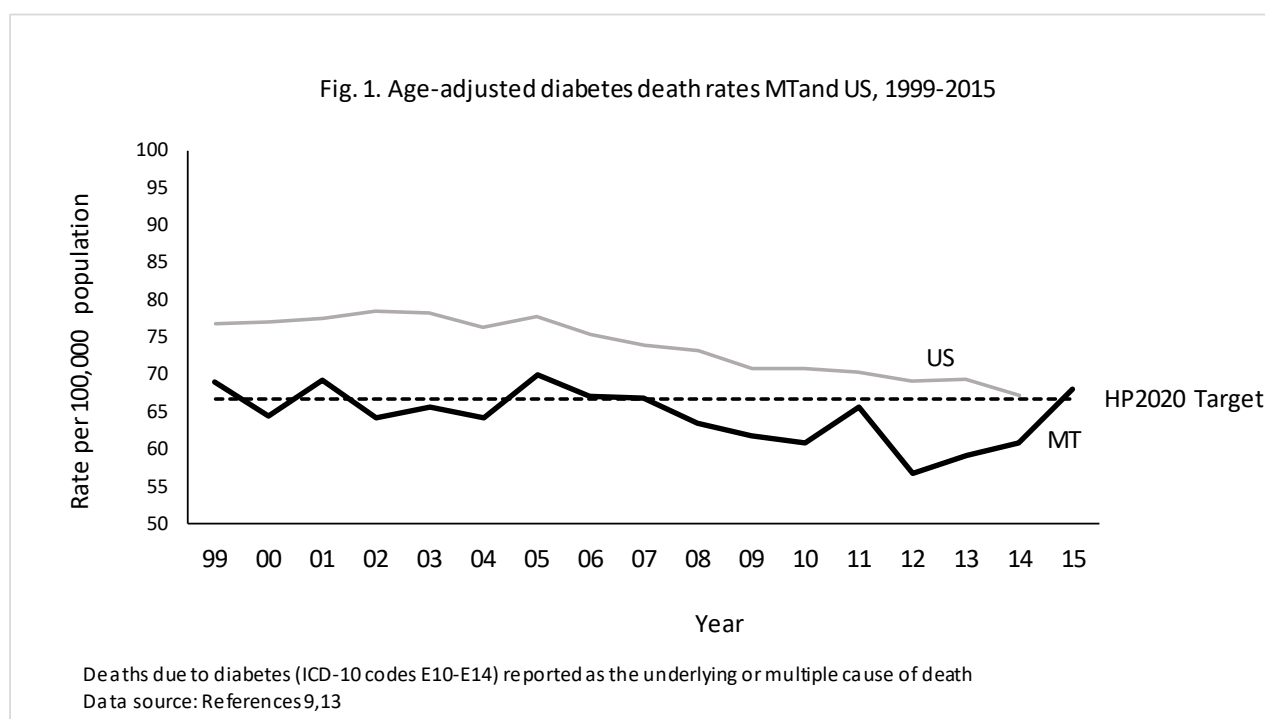
Contributing cause (multiple cause of death) can also be assigned and include diseases or injuries which contributed to death in an ordered listed on the death certificate.

ICD (International Classification of Diseases) provides rules for uniform system of coding and classifying causes of death.

Diabetes-related Deaths, Overall Findings

Diabetes was the seventh leading underlying cause of death in MT and U.S in 2015.^{9,10} It was reported as the cause of death for approximately 3% of all deaths. However, a recently published study suggests that diabetes deaths are underestimated and account for approximately 12% of all deaths. Based on these estimates, this would make diabetes the third leading cause of death in the United States in 2010, after diseases of the heart and cancer and ahead of chronic lower respiratory diseases and cerebrovascular diseases.^{11,12}

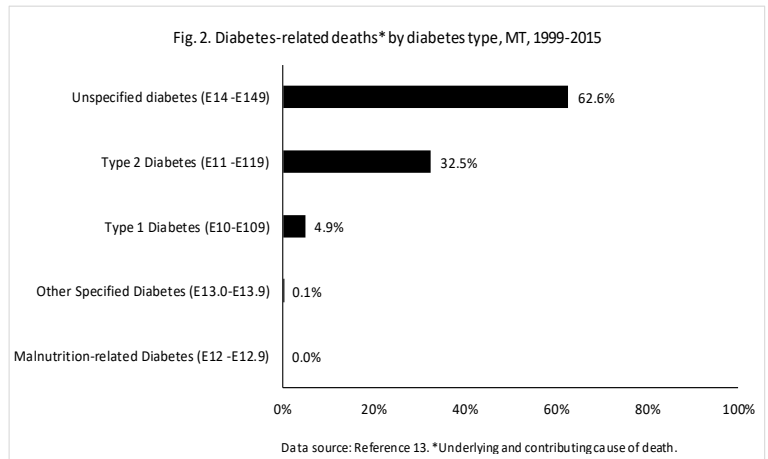
MT's age-adjusted diabetes death rate was lower than the corresponding U.S. age-adjusted diabetes rate for all years since 1999. U.S. estimates are not yet available for 2015 [Fig.1].¹³ Nonetheless, over the past 17 years; the U.S. age-adjusted diabetes death rate has trended downward, compared to MT's death rate trending upwards since 2012. MT met the Healthy People (HP) 2020 diabetes death rate of 66.6 deaths per 100,000 population, nine out of the 17 years (2000, 2002, 2004, 2008-2010, 2012-2014) whereas the U.S. met this benchmark only in 2014.



From 1999 through 2015, a total of 142,887 deaths were registered in MT. Diabetes-related deaths accounted for 8.6% of all MT deaths. In the 17 year period, diabetes was listed as an underlying cause of death on 4,152 (33.9%) death certificates with an additional 8,113 (66.1%) death certificates on which diabetes was listed as contributing cause of death for a total of 12,265 diabetes-related deaths. Two out of three diabetes deaths were recorded as a contributing cause.

Diabetes-related Deaths by Diabetes Type

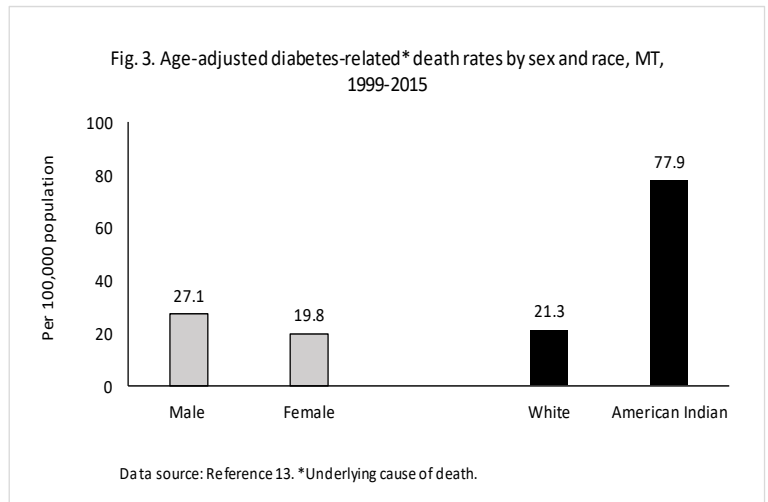
Among the 12,265 deaths attributed to diabetes, nearly two-thirds were from unspecified diabetes, 32.5% were from type 2 diabetes, and 4.9% were from type 1 diabetes [Fig. 2]. Only 0.1% of all the diabetes deaths were listed as other specified diabetes and no diabetes deaths were listed as primarily malnutrition-related diabetes.



Diabetes-related Deaths, by Sex and Race

With respect to sex, the diabetes age-adjusted death rates were significantly higher for men compared to women [Fig. 3].

In 2015, 19.1% of American Indians had diabetes.¹ Diabetes death rates were significantly higher for American Indians (77.9 (95% CI: 70.1-85.7) per 100,000) compared to Whites (21.3 (95% CI: 20.6-22.0) per 100,000) [Fig. 3]. The percentage of deaths for American Indians should be interpreted with caution due to misclassification of race for American Indian population on death certificates.^{14,15}



Diabetes-related Deaths, by Age-Specific Group

Age-specific diabetes death rates were significantly lower for all age groups, compared to age-specific death rates from all-causes [Table 1]. As mentioned earlier, due to the limitations of death certificate data, diabetes mortality rates are likely underestimated.⁹ Given that the majority of diabetes deaths are preventable and these data show that more needs to be done to prevent premature death.

Data source: Reference 13. *Diabetes-related deaths include underlying and contributing cause of death. For reliability reasons, rates for events <20 were not calculated.

Table 1 All-cause and diabetes-related death rates, by age-specific groups, MT, 1999-2015

Age Group	Total deaths (All causes)	Mortality rate/100,000 population	Diabetes deaths	Mortality rate/100,000 population with diabetes
1-17	1,048	29.0	4	*
18-29	2,805	108.1	41	1.6
30-39	2,884	147.3	105	5.4
40-49	6,108	264.0	391	17.0
50-59	12,757	542.2	1,075	45.7
60-69	19,286	1,162	2,002	120.7
70-79	30,442	3,000	3,315	326.8
80 +	67,557	10,383	5,332	819.5
Total	142,887	884.7	12,265	75.9

Diabetes-related Deaths, Children and Young Adults Aged 1 through 29 years

Children and young adults aged 1 through 29 years, with diabetes are at risk for diabetes-related deaths because of acute complications that can result from the disease including DKA and hypoglycemia.¹⁶ Among all diabetes deaths, acute metabolic complications (ketoacidosis and hypoglycemia) were the leading underlying cause of death for children aged 1-17 years and young adults aged 18-29 years but not as common for older adults [Table 2]. In contrast, disease of heart or cancer were more common underlying cause of death for older adults than acute metabolic complications. In addition to the 13 diabetes deaths where acute metabolic complications was listed as underlying cause, there were three more diabetes deaths with acute metabolic complications listed as contributing cause of death for those aged 1 through 29 years [data not shown]. These findings demonstrate the need for continued improvement in diabetes diagnosis and care especially among younger population.

Table 2 Number of diabetes-related deaths by leading underlying cause of death by age group, MT, 1999-2015

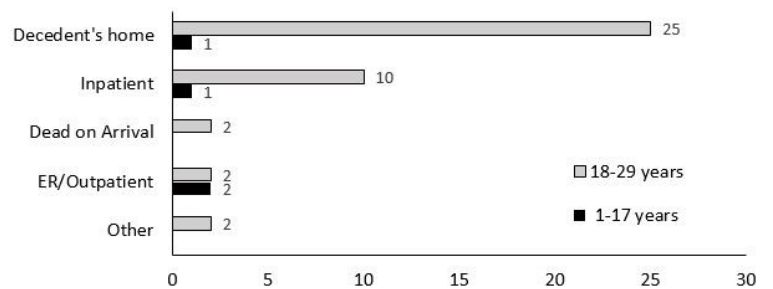
Age Group	Acute metabolic complications	Accidents (unintentional injury)	Chronic lower respiratory diseases	Type 1 or 2 diabetes without complications	Cancer	Disease of heart	All other causes	Total
1-17	2	1	0	0	0	0	1	4
18-29	11	2	0	5	0	1	22	41
30-39	9	4	0	10	1	11	70	105
40-49	17	20	6	48	8	79	213	391
50-59	19	15	44	77	67	264	589	1,075
60-69	16	26	124	155	201	502	978	2,002
70-79	7	40	253	238	413	768	1,596	3,315
80 +	9	88	232	447	410	1,229	2,917	5,332
Total	90	196	659	980	1,110	2,854	6,386	12,265

Data source: Reference 13. Diabetes-related deaths include underlying and contributing cause of death.

Place and Time of Death

Two of the four diabetes deaths in children aged 1 through 17 years occurred in the ER [Fig. 4.]. Over 60% (25/41) of diabetes deaths in young adults aged 18 through 29 years occurred at the decedent's home and 24% occurred in a hospital. Most (3) of the children's diabetes deaths happened between midnight and 10 am. About 50% (17/33) of the young adults with diabetes deaths took place during the same time frame [data not shown].

Fig. 4. Number of diabetes-related deaths* for children aged 1-17 years and young adults aged 18-29 years by place of death, MT, 1999-2015



Conclusion

The national decline in the diabetes-related deaths suggests that those with diabetes and many with significant comorbidities will live longer. Still, adults with diabetes have a 50% increased risk of death from any cause compared to adults without diabetes.¹⁷ People with diabetes typically have other conditions that may contribute to death.

Diabetes complications listed on diabetes-related death certificates show that acute metabolic complications were substantially elevated among children and young adults, whereas diseases of heart, chronic lower respiratory disease, and other factors were more frequent in older adults.

Deaths from acute metabolic complications are often preventable with aggressive intervention by those with diabetes, healthcare providers, and diabetes educators. These results suggest that diabetes management especially in children and young adults can prevent development of health complications or premature death.

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Recommendations for Clinicians and Educators

Type 1 Diabetes

1. Increase public awareness of the signs and symptoms of type 1 diabetes, in efforts to recognize, diagnose and treat it earlier.
2. Promote education (DSME/S) for individuals with type 1 diabetes and their support system (i.e. caregivers, extended support/friends) to prevent DKA and empower the person with diabetes and their support system to be proactive about warning signs.
3. Engage patients in professional DSME/S for those with type 1 diabetes in the causes of severe hypoglycemia and develop plans to prevent and treat hypoglycemia.
4. Ensure that patients know the benefits and limitations of insulin pumps as a tool to manage blood glucose and the risk for DKA associated with pump failures. A new pump option this year is the FDA-approved hybrid closed loop insulin pump which delivers insulin 24 hours a day at a personalized, variable rate to maximize glucose control.¹⁸
5. Provide support for the student with diabetes in the school setting by providing a DMMP (i.e. Provider Orders), algorithm for blood glucose values, an Individualized Health Plan, and other appropriate plans to ensure safety and health. Provide training to school staff. See MT DPHHS School Health website: <https://dphhs.mt.gov/schoolhealth> for sample plans and resources, online training modules, and toolkits.
6. Provide 'transition' care from pediatric diabetes care to adult care management of type 1 diabetes. This is an ongoing, long-term plan that is started early and helps to prepare those living with type 1 diabetes to transition to the work environment or to post-secondary education setting.

Diabetes

1. Refer to Diabetes Prevention Programs (DPP) and Diabetes Self-Management Education and Support (DSME/S) Programs, which have been proven effective to prevent or delay type 2 diabetes and diabetes-related complications, respectively. Reimbursement by Medicaid and Medicare supports utilization of these services. Find these programs in your community at <https://dphhs.mt.gov/publichealth/chronicdisease> or by calling 1-800-844-MTHLT4U (1-800-684-5858).
2. Explain modifiable risk factors related to preventable deaths. Educate on avoiding accidents and risky behaviors such as falls, unsafe driving, tobacco use, alcohol use, and substance abuse. Discuss how to manage sick days in efforts to avoid acute metabolic deaths. Promote regular exams for eyes, feet, and kidneys and monitoring of blood pressure and cholesterol to keep people vigilant on potential microvascular and macrovascular complications.²
3. Provide education in a way that factors in health literacy and numeracy skills so that the health information and services are understood and used.²
4. Let patients know that treatments are available that reduce the risk for death. Metformin among overweight patients shows significant risk reductions for death from any cause. New medications have made therapeutic breakthroughs for reducing deaths. Recent studies on glucose-lowering agents, specifically the SGLT-2 inhibitor empagliflozin and the GLP-1 agonists liraglutide and semaglutide, have shown reduced death rates from cardiovascular events such as heart attack and stroke by up to 39%.^{2,19} The former two medications are FDA-approved and the latter is pending.
5. Screen for diabetes distress and depression, and provide referrals to mental health services if needed. The Problem Areas in Diabetes (PAID) Questionnaire is a useful 20-item measure of diabetes-specific emotional distress. A version is available at www.dawnstudy.com. MT resources are available at <https://dphhs.mt.gov/amdd>. Consider family/individual counseling when there are indications of diabetes distress and inability to cope with diabetes. If you identify someone in crisis and want to help, reach the MT Suicide Prevention Lifeline, 24/7, by calling 1-800-273-TALK (1-800-273-8255) or texting "MT" to 741 741.
6. Consider demographic, socioeconomic, and psychological factors that impact ability to self-manage diabetes such as lack of insurance, food insecurity, homelessness or transitional living circumstances, and social support.²⁰



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Surveillance Report:

Montana Deaths Caused by Diabetes

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- Overall the **risk of death among people with diabetes is twice** that of people of similar age without diabetes.

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