Chapter 6

Diabetes, Foot Disease and Lower Limb Amputations in Alberta

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DIABETES, FOOT DISEASE AND LOWER LIMB AMPUTATIONS IN ALBERTA

KEY MESSAGES

- In 2007, people with diabetes were 15 times more likely to have a lower limb amputation than people without diabetes.
- Lower limb amputations were twice as common in males than in females with diabetes.
- The relative risk of lower limb amputation in younger adults with diabetes is significantly higher compared to older adults with diabetes.
- In 2007, people with diabetes were twice as likely to have foot disease than people without diabetes.
- The highest rates of foot disease are in people with diabetes who are 75 years or older.
- The rates of diabetic foot disease are similar throughout the Alberta health zones, but rates of lower limb amputations are highest in the North and Central zones.

BACKGROUND

Foot problems are a significant complication for people with diabetes. More specifically, people with diabetes often develop foot disease (i.e. foot ulcer, cellulitis, osteomyelitis) as a result of diabetic peripheral neuropathy (DPN) or atherosclerotic peripheral arterial disease (PAD), which may eventually lead to lower limb amputations.[1] In people with diabetes, foot ulceration is usually a consequence of:

1) impaired sensation, which results in the loss of the protective sensation in the foot;

2) structural abnormalities, which result in increased pressure and tissue breakdown;

3) poor blood flow to the injured area, which then interferes with the healing process.

Commonly all these factors operate together. Susceptibility to injury and poor wound healing can lead to ulceration, and unless treated promptly, foot ulcers may become infected particularly when diabetes control is poor. Soft tissue infection may progress to involve the underlying bone. These deeper infections are usually very difficult to treat and may eventually require amputation. Similarly, when the extremities of the body are deprived of oxygen due to PAD, tissue death may result, leading to ulceration and/or gangrene. If revascularization is not possible and gangrene develops, amputation is usually required.

Lower limb problems are a major cause of morbidity and mortality in people with diabetes and contribute to increased healthcare costs.[2,3] The risk of lower limb amputations following a diagnosis of diabetes is 6% at 20 years and 11% at 30 years.[4] Similarly, 5-year mortality rates after new-onset diabetic ulceration have been reported between 43% and 55%, and are as high as 74% for patients who had a lower limb amputation.[5] Foot ulcers and amputations can be prevented with proper foot care and prompt treatment of ulcers at their initial stage.[2]

Besides increased health care costs and increased mortality rates, people with foot ulcers and/or lower limb amputations have a decreased health-related quality of life.[6,7] These individuals often have long treatment periods that can be both painful and time consuming, with much time spent at clinic visits, hospitalization and frequent foot ulcer dressing changes with or without long term antibiotic therapy.[7] If a lower limb amputation results, patients are faced with many challenges such as needing assistance with activities of daily life.

METHODS

Data from Alberta Health and Wellness (AHW) Physician Claims databases were utilized for these analyses. This dataset captures Alberta resident demographic information, and procedural and diagnostic codes for lower limb amputations and foot disease, respectively.

In the previous version of the *Alberta Diabetes Atlas*, we had only reported on lower limb amputation procedures. We had also excluded accompanying diagnostic codes that were related to trauma and other specific causes, such as neoplasms, osteomyelitis and congenital abnormalities. In order to be consistent with the National Diabetes Surveillance System approach, in this current version of the *Atlas*, we no longer applied this exclusion criterion. The rationale for this is that some of the lower limb amputations that were excluded based on their accompanying diagnostic codes may have in fact still been systematically different for people with diabetes. Therefore, we wanted to reduce the possibility of under- or over-estimating the amount of lower limb amputations in people with diabetes.

The previous version of the *Atlas* also did not include specific information about general foot disease among people with and without diabetes. In this version of the *Atlas*, we have expanded this chapter to report on any foot disease diagnosis (see appendix).

We included all related procedures and diagnoses coded by any physician specialty, including podiatrists. Podiatric physician specialty codes were only available past 2006. All adult residents of Alberta who were 20 years or older were included in these analyses.

From the procedural codes for lower limb amputations and the diagnostic codes for foot disease, we calculated age- and sex-adjusted rates for those with and without diabetes (1995-2007), age-adjusted rates for people with diabetes by sex (1995-2007), and age-specific rates for 2007. For both people with and without diabetes, the number of individuals with lower limb amputations or foot disease (numerator) was divided by the total number of people in the zone or province (denominator), respectively. We also present the counts of lower limb amputations (1995-2007).

FINDINGS

Foot Disease

From 1995-2007, people with diabetes were approximately 2 times more likely to have foot disease than people without diabetes, after adjusting for age and sex (Figure 6.1). These rates were relatively stable over the years in both people with and without diabetes. Sex differences did occur, where rates of foot disease were about 10% higher in males with diabetes than in females with diabetes in 1995 (Figure 6.2). From 1995-2007, however, the rates of foot disease declined slightly in males with diabetes and increased slightly in females with diabetes, so that by 2007, the rate of foot disease was 2% lower in males with diabetes.

Figure 6.1 **Age- and Sex-Adjusted Rates of Foot Disease, 1995-2007**

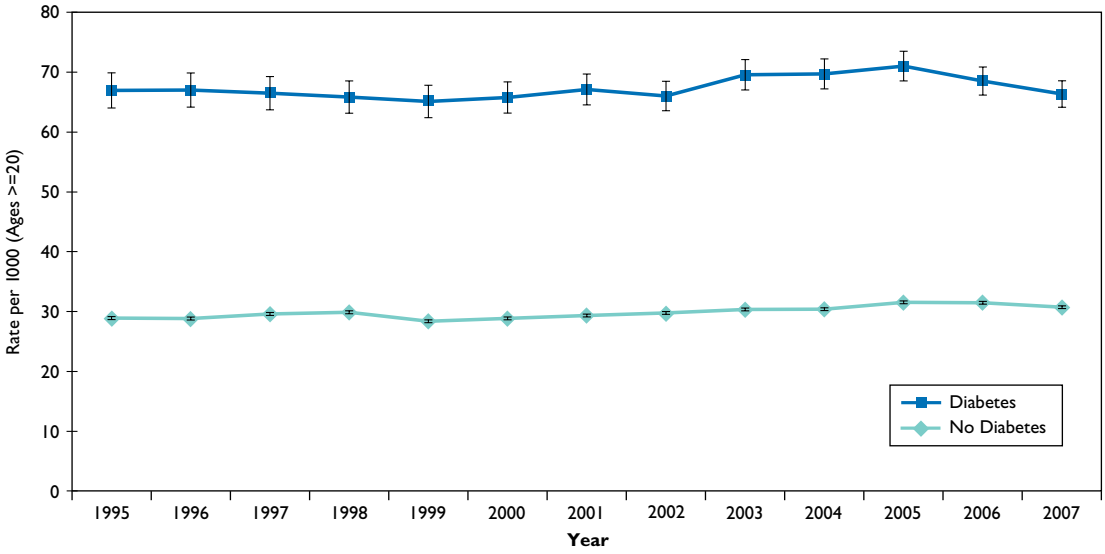
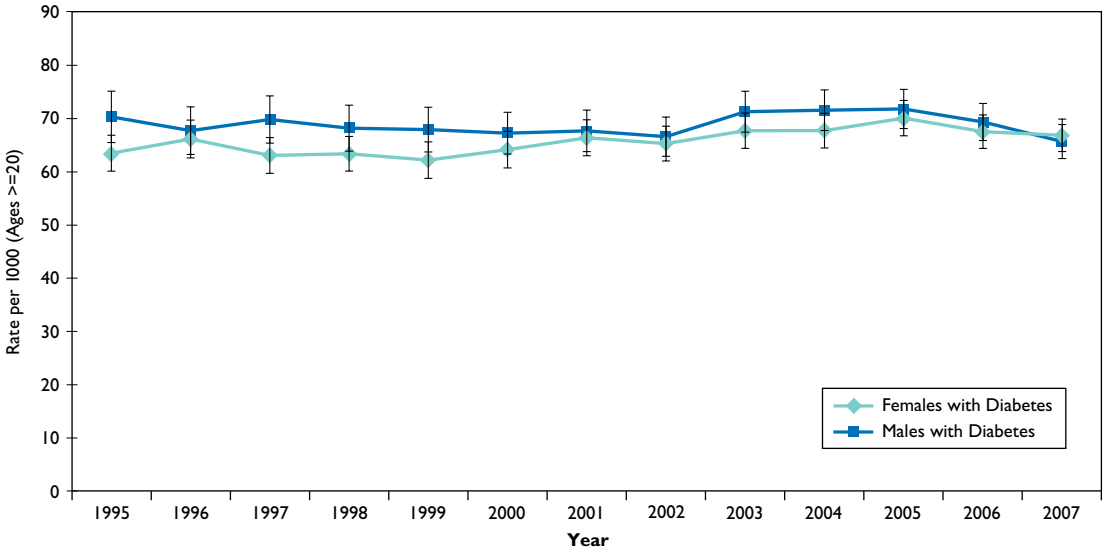


Figure 6.2 **Age-Adjusted Rates of Foot Disease in People with Diabetes, 1995-2007**



The rates of foot disease in people with diabetes are consistently higher compared to people without diabetes, across all age groups (Figure 6.3). There is a trend of increasing rates of foot disease across age groups in both the diabetes and non-diabetes groups, with the highest rates being in the 75-plus age group. However, the rate ratio (or relative risk) of 2.3 is higher in the 20-34-year-old age group, and decreases to 1.5 in the 75-plus age group. Therefore, although there is more foot disease overall in older patients, the relative risk of foot disease is somewhat higher in younger adults with diabetes compared to older adults.

The age-adjusted rates of foot disease for individuals with diabetes were similar across the health zones. It was notable, however, that for individuals without diabetes, the Edmonton zone had a higher rate of foot disease (Figure 6.4).

Figure 6.3 **Age-Specific Rates of Foot Disease, 2007**

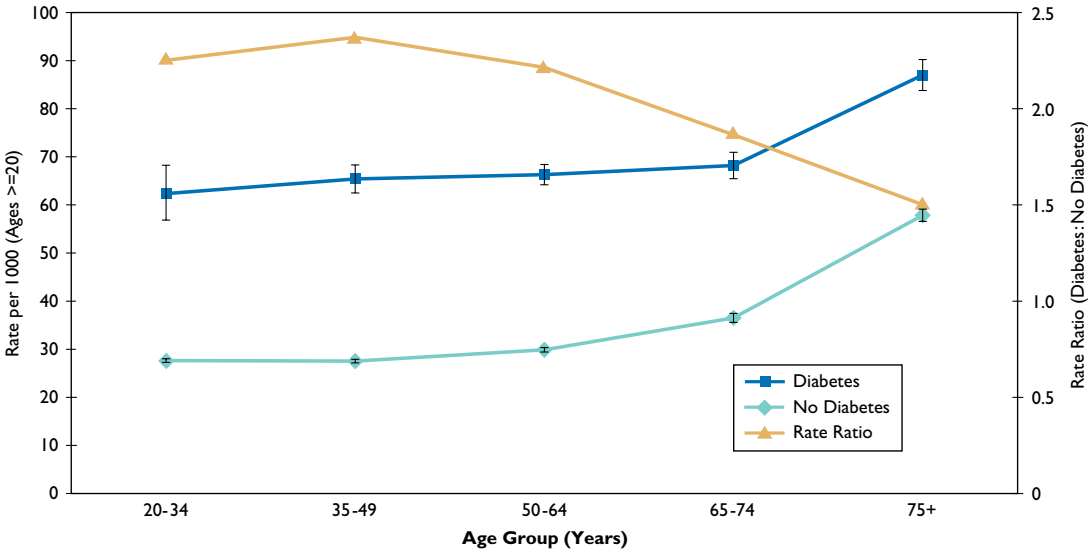
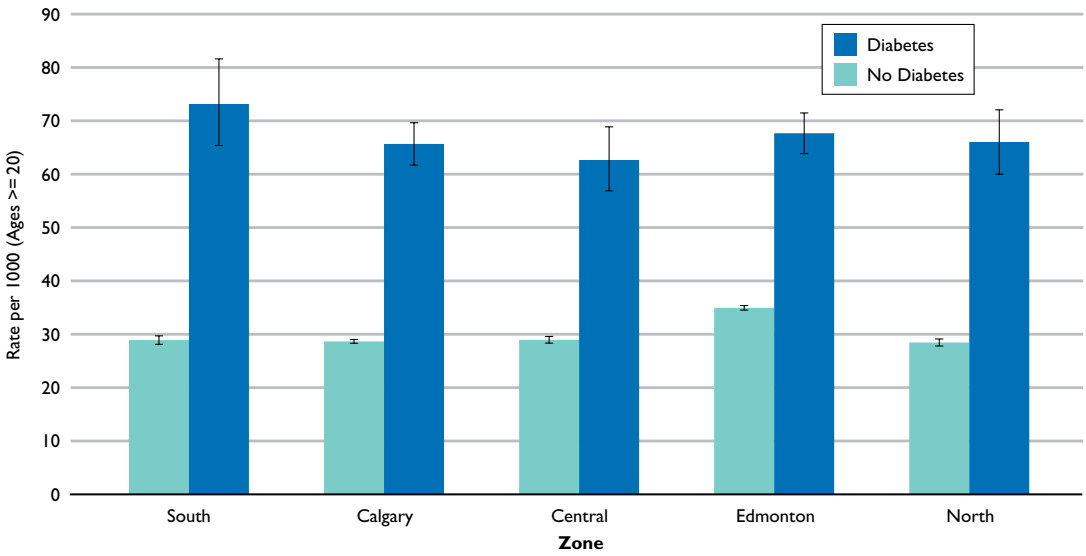


Figure 6.4 **Age-Adjusted Rates of Foot Disease by Zone, 2007**



Lower Limb Amputations

Lower limb amputation is a serious complication in people with diabetes and is rare in people without diabetes. From 1995-2007, people with diabetes were approximately 15 times more likely to have a lower limb amputation than people without diabetes, after adjusting for age and sex (Figure 6.5). Although the ratio between those with and without diabetes remained constant over the 13 years, rates of lower limb amputation decreased in people with diabetes, particularly from 1995-1999. Lower limb amputations were about twice as common in males with diabetes than in females with diabetes (Figure 6.6). Lower limb amputations were not common in young people without diabetes, but become more common in older adults with and without diabetes (Figure 6.7). The rate ratio (or relative risk) demonstrates that the risk of lower limb amputation is much greater for adults with diabetes compared to those without diabetes. While there were a higher number of lower limb amputations in older patients, the relative risk is much higher in younger adults with diabetes compared to older adults with diabetes. In fact, in the youngest age group of 20-34 years, those with diabetes were 30 times more likely to have a lower limb amputation than those without diabetes. In adults 75 years and older, those with diabetes were only 7 times more likely to have a lower limb amputation than those without diabetes. The higher rate of lower limb amputation in the older population is likely due to increased PAD in both groups. The excess of lower limb amputations in younger adults with diabetes is likely due to an excess of peripheral neuropathy rather than PAD alone.

Figure 6.5 **Age- and Sex-Adjusted Lower Limb Amputation Rates, 1995-2007**

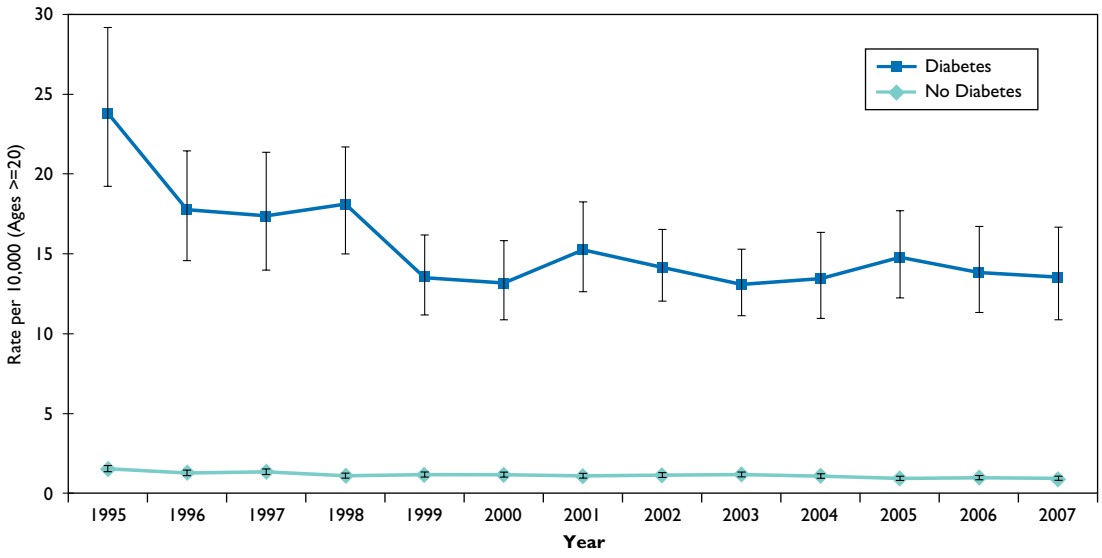


Figure 6.6 **Age-Adjusted Lower Limb Amputation Rates in People with Diabetes, 1995-2007**

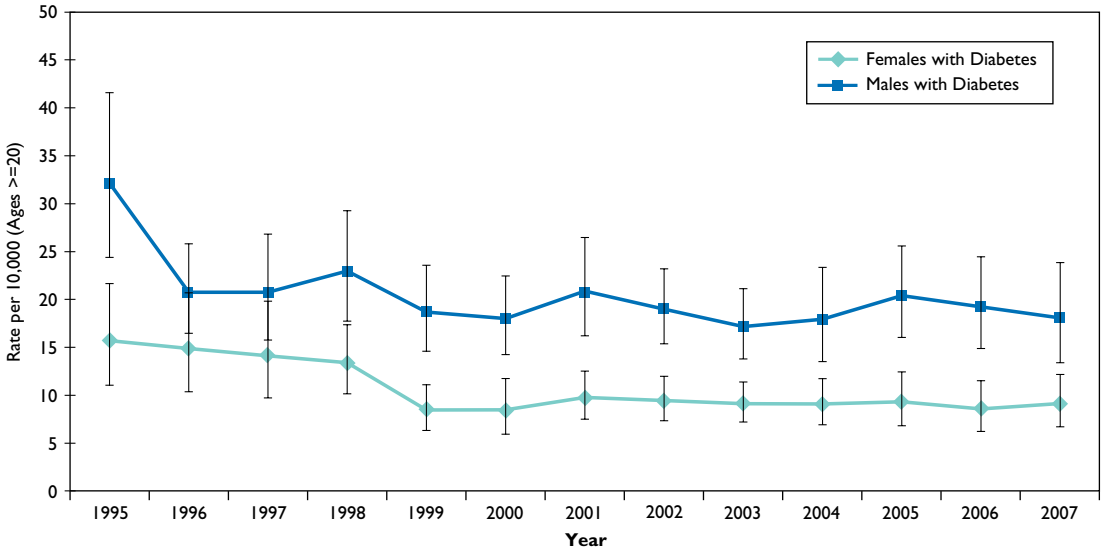
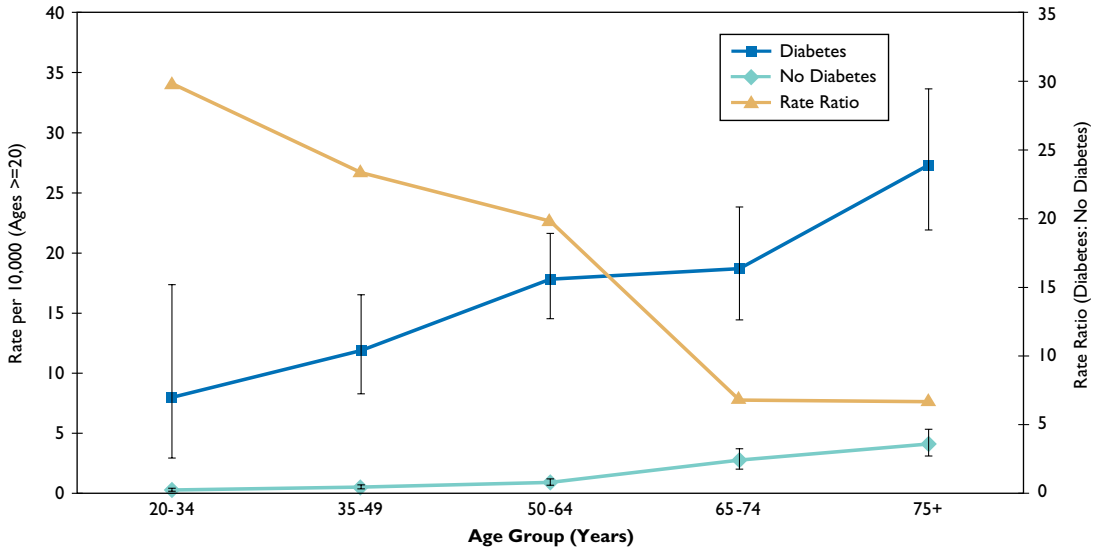
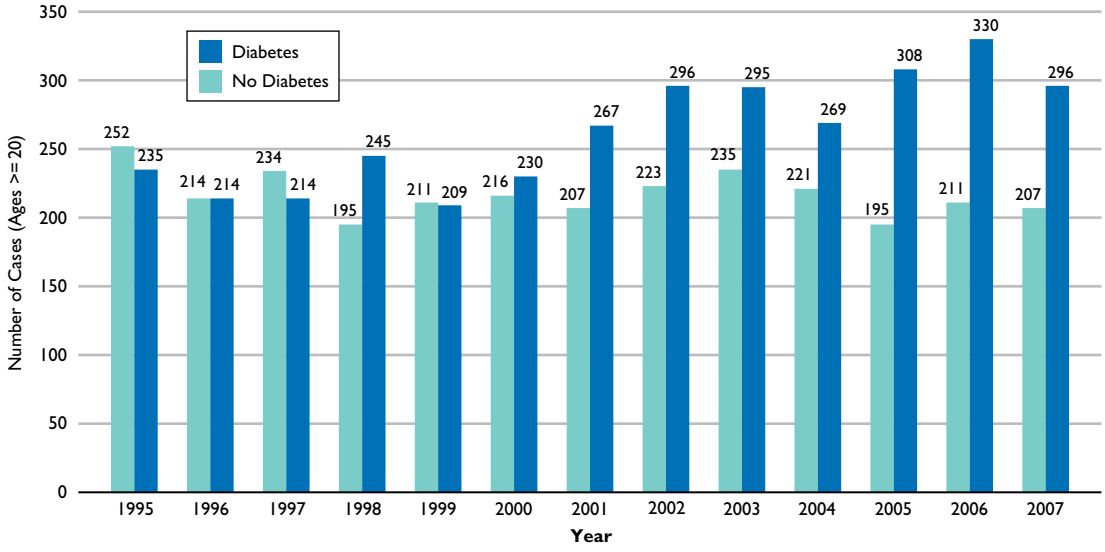


Figure 6.7 **Age-Specific Lower Limb Amputation Rates, 2007**



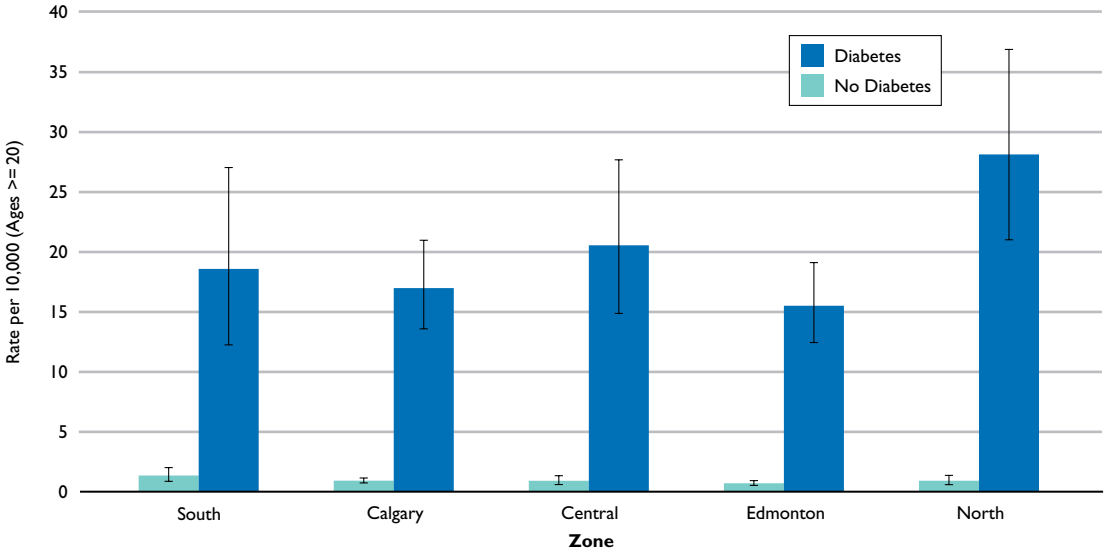
The actual number of lower limb amputations was higher in people with diabetes compared to those without diabetes, from the year 2000 and onward (Figure 6.8). The number of lower limb amputations in people with diabetes increased over time from 1995-2007, whereas that number remained fairly constant over time in people without diabetes.

Figure 6.8 **Number of Lower Limb Amputations, 1995-2007**



The rate of lower limb amputations is represented as a crude rate due to the small number of amputations occurring in the zones. The North and Central zones had the highest rates of lower limb amputations at 28.1 and 20.6 per 10,000 people, respectively (Figure 6.9).

Figure 6.9 **Crude Lower Limb Amputation Rates by Zone, 2007**



DISCUSSION

Foot disease (i.e. cellulitis, ulcers, osteomyelitis and gangrene) and lower limb amputations cause a significant amount of morbidity in people with diabetes. The above findings stress the need for life-long surveillance of the diabetic foot and the necessity of preventative foot care among diabetic patients.[3] Although the absolute number of people with diabetes that ultimately receive lower limb amputations are relatively small, the burden that amputation places on patients is very large. Also, due to the preventable nature of this complication, diabetic foot care is a very important aspect of the management of diabetes in Alberta. The rate of lower limb amputations has been suggested as an indicator of overall quality of care for diabetes.[8]

As previously noted, foot ulcers and lower limb amputations are a result of two different processes in people with diabetes. Decreased sensation due to DPN (nerve damage) makes it hard for people with diabetes to feel small cuts or damage to the foot, and poor blood flow to the legs and feet (PAD) prevents healing of these small cuts, allowing them to worsen. Diabetes itself, particularly if poorly controlled, increases the risk of ulcers becoming infected. Reducing the risk of lower limb amputations therefore requires multiple prevention strategies, including regular foot checks by the person with diabetes themselves, as well as by their health care providers.[2]

Poor blood circulation in the lower limbs is due to atherosclerosis, the same disease process that affects blood vessels of the heart (leading to heart attacks) and the brain (leading to stroke).[9,10] Atherosclerosis refers to the buildup of cholesterol in the arteries, which over time leads to the narrowing of blood vessels that impairs blood supply. Reducing the risk of lower limb amputation therefore requires the same preventative treatment. Treatment includes cholesterol lowering, blood pressure lowering, anti-platelet (ASA) therapy and revascularization similar to that used to prevent and treat heart attacks and strokes. Unfortunately, there is evidence to suggest that people with diabetes and PAD are not optimally treated to reduce their risk of heart attacks or stroke.[11-13] Notably, lower limb amputation could be thought of as the "tip of the iceberg," as it is a marker for end stages of DPN and PAD. There are a great deal many more patients with less severe (but still serious) forms of the disease who would benefit from better preventive therapies.

It is encouraging to see a steady reduction in the rate of lower limb amputations for males and females with diabetes in Alberta, over the past 13 years. The 15-fold increase in lower limb amputations that we observed in people with diabetes compared to people without diabetes was lower than that observed by the Institute for Clinical Evaluative Sciences (ICES) Practice Atlas for Diabetes in Ontario. ICES found that people with diabetes in Ontario were 20 times more likely to have an amputation than people without diabetes.[14] Similar to findings from the ICES, we found that lower limb amputations were more common in males than females with diabetes. We also observed a two-fold higher rate of foot disease in people with diabetes than in people without diabetes with the highest foot disease rates in the oldest age group (75 years or older). It is concerning, however, that we have not seen a decrease in rates of foot disease over the past 13 years. Therefore, ongoing efforts to prevent and minimize diabetic foot disease in people with diabetes, such as regular foot examinations and annual screening

for peripheral neuropathy, are required to further reduce rates of lower limb amputations in this population. Similarly, proper blood pressure, lipid and glucose control may reduce incidence of lower limb amputations in people with diabetes.

There is considerable variation in the rate of lower limb amputations across the health zones of the province. It appears that those living in the North and Central zones have higher rates of limb amputation, yet have similar rates of foot disease. Differences in these amputation rates may reflect different levels of risk for people with diabetes in these zones, different access to health care providers, delay in seeking medical attention or in treating ulcers, or differences in the decision-making to undergo an amputation. As with many other trends observed in this *Alberta Diabetes Atlas*, further investigation is needed to better understand the reasons for the patterns, which, in turn, may inform policy and program planning to support improved access and outcomes for people living with diabetes.

APPENDIX

Lower Limb Amputation

Alberta Physician Claims Data

Procedure	Procedure Codes
Amputation and disarticulation of one toe	96.11A, 96.11AA, 96.11PA
Amputation and disarticulation of foot: Metatarsal	96.12A, 96.12AA, 96.12AB, 96.12AC
Amputation and disarticulation of foot: Transmetatarsal	96.12B, 96.12PB
Amputation and disarticulation of mid-tarsal	96.12C, 96.12PC
Amputation and disarticulation of foot: Metatarsal – whole ray	96.12PA
Amputation and disarticulation of ankle: Symes, Pirogoff	96.13
Amputation of lower leg below knee	96.14
Amputation of thigh or disarticulation of knee: Supracondylar Thigh through femur	96.15

Foot Disease

Alberta Physician Claims Data

Diagnosis	ICD-9-CM
Cellulitis and abscess of finger and toe	681
Toe	681.1X
Unspecified digit	681.9
Other cellulitis and abscess	682
Leg, except foot	682.6
Foot, except toes {Excludes: toe (681.1)}	682.7
Chronic ulcer of skin {Excludes: Gangrene (785.4); Skin infection (680-686)	707
Decubitus ulcer	707.0
Ulcer of lower limbs, except decubitus	707.1X
Chronic ulcer of other specified sites	707.8
Chronic ulcer of unspecified site	707.9
Ulcer of ankle	707.13
Ulcer of heel and midfoot	707.14
Ulcer of other part of the foot	707.15
Arthropathy associated with other endocrine; metabolic disorders Excludes: arthropathy associated with amyloidosis (713.7); arthropathy associated with diabetic neuropathy (713.5); arthropathy in gout and other crystal deposition disorders	713.0
Lower leg	713.06
Ankle and foot	713.07
Osteomyelitis, periostitis and other infections involving bone	730
Acute osteomyelitis	730.0
Lower leg	730.06
Ankle and foot	730.07
Chronic osteomyelitis	730.1
Lower leg	730.16
Ankle and foot	730.17
Periostitis without mention of osteomyelitis	730.3
Lower leg	730.36
Ankle and foot	730.37
Gangrene	785.4
Gas gangrene	040.0

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