Diabetes Mellitus Related Morbidity, Risk of Hospitalization and Disability

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Objective.—To investigate the rates of complications, hospitalizations and disabilities attributable to type 1 and type 2 diabetes mellitus (DM) combined, unless otherwise noted.

Methodology.—Risk assessment of DM-related morbidity, hospitalizations and disabilities using data from the medical literature and health statistics on the population. Calculation of morbidity, hospitalization, and disability ratios (MbR, HR, DR) will allow comparison of observed rates in people with DM to those reported in the nondiabetic population.

Results.—MbRs vary according to the morbid condition studied: ~300% at age 45–64 years for ischemic heart disease, 533% for coronary heart disease or stroke, 226% to 388% for chronic heart failure, 560% for peripheral vascular disease, 380% for neuropathy at age 35–74 years, 890% to 2225% for lower limb amputations, 1458% to 3287% for end-stage renal disease. For ocular complications: cataracts, 165% to 232%; glaucoma 140% to 330%; trouble seeing, 180% to 231%; blindness at age ≥65 years, 517%. Higher values are noted at younger ages. HR: 200% to 409%. DR: 217% to 328%.

Conclusion.—Among diseases, DM is one of the leading and growing causes of hospital admission and disability. Precise risk assessment of morbidity is essential for realistic underwriting of health and disability insurance.

Diabetes mellitus (DM) is one of the most common chronic diseases in the world. Its prevalence approaches 8% to 10% of the adult population of the United States or Europe, and affects more than 100 million cases worldwide. It is estimated that about 1.5 million Canadians (5% of the population) have been diagnosed with DM and that nearly 3% to 5% of adults have undiagnosed type 2 diabetes. In the United States, DM incidence is growing, not only due to aging of the American population. Trends show that the native minority and the elderly are even more affected by DM. Between 1980 and 1996, the number of persons with diagnosed DM in the United States increased by 2.7 million. In 1996, about 8.5 million persons in the United States (3.2% of population) reported that they had DM. This figure increased to 12 million Americans reporting they had DM in 2000. Because DM is often asymptomatic in the early stages, it is frequently undiagnosed for many years. Insulin resistance and hyperglycemia develop gradually, while pathological and functional changes in various target tissues may not be severe enough for patients
to notice any of the classic symptoms of the disease.\textsuperscript{4}

For more precise correlation with the glucose tolerance test and glycemia associated with microvascular complications, a new criterion for the diagnosis of DM was published in 1997 by the American Diabetes Association (ADA).\textsuperscript{5} The diagnostic level for fasting plasma glucose (FPG) was set at \textasciitilde 7.0 mmol/L to minimize the discrepancy in 1995 World Health Organization (WHO) criteria, by which diabetes was diagnosed by either FPG \textasciitilde 7.8 mmol/L or 2-hour post load plasma glucose (2-h PG) \textasciitilde 11.1 mmol/L during the 75 g oral glucose tolerance test.\textsuperscript{6} In 1999, the WHO made further recommendations to define DM.\textsuperscript{7,8}

The predominant clinical form of DM is type 2 or non-insulin-dependent, which accounts for more than 90\% of all cases.\textsuperscript{9} Non-insulin-dependent diabetes mellitus (NIDDM) may be the most rapidly growing chronic disease in the world. Its long-term complications, including retinopathy, nephropathy, neuropathy and accelerated macrovascular disease, cause major morbidity and mortality.\textsuperscript{10} Diabetes is associated with a worldwide socioeconomic burden: DM-associated disabilities reduce the quality of life and result in massive, rising direct and indirect medical costs.\textsuperscript{11,12} In 1992, diabetics constituted 4\% of the US population but accounted for 14.6\% of total US health care expenditures ($105 billion). It was estimated that per capita annual health care expenditures were more than 4 times greater than for nondiabetics.\textsuperscript{13} Although these costs derive from a variety of factors, chronic complications account for more than 50\% of the total cost of diabetes.\textsuperscript{14}

Underwriting disability and health insurance in people with diabetes could be refined through a review of the medical literature during the last decade. As suggested by Singer,\textsuperscript{15} life table methodology could be applied to determine morbidity ratios (MbR) using an approach similar to mortality studies. MbR is the ratio of the “observed” morbidity rates in diabetic patients to either the rates in nondiabetic patients or to the rates in the general population as specified (“expected” morbidity events rate); the ratio is a decimal that is multiplied by 100 to obtain a percent. Hospitalization and disability risks could be established by calculating hospitalization ratios (HR) and disability ratios (DR). The “normal” or standard risk is 100\%.

We summarized representative MbR, HR and DR results calculated from data presented in publications surveyed in our literature review (large cohorts, large registries) for Tables 1–4. Details of our review of diabetes-related morbidity, hospitalization and disability are included in the following text.

**DIABETES MELLITUS AND MORBIDITY**

The risk of morbidity attributable to DM can be assessed by calculating MbRs for each morbidity event from observed rates in the diabetic population compared with rates in the nondiabetic population. MbRs are expressed as percentages, 100\% being the standard or “normal risk,” 200\% corresponding to 2-fold risk, 300\% to 3-fold risk, and so on. We will review the macrovascular (cardiovascular) and microvascular (ocular, renal and neurologic) complications related to DM. Tables 1 and 2 summarize the MbRs for different morbidity events. In different age groups, we calculated from data presented in representative studies surveyed in our literature review.

**Cardiovascular Complications**

Previously-diagnosed DM, newly-diagnosed DM and impaired glucose tolerance are important determinants of the risk of clinical cardiovascular disease.\textsuperscript{16} There is widespread agreement that type 2 diabetes increases the age-related risk of coronary artery disease and peripheral, as well as cerebrovascular disease in most populations.\textsuperscript{9} Based on the large 1989 US National Health Interview Survey (NHIS), the prevalence of self-reported ischemic heart disease (IHD), heart and rhythm disorders, as well as atherosclerosis in the United States was higher among adults with than without self-reported diabetes.\textsuperscript{17} The percentage of American
Table 1. Morbidity Ratios (MbR) of Macrovascular Complications by Age Group: Diabetics vs. Non-Diabetics Based on Representative Studies Referenced in This Review

<table>
<thead>
<tr>
<th>Macrovascular Complications</th>
<th>Age (Years)</th>
<th>Morbidity Ratios MbR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic heart disease$^{17}$</td>
<td>18–44</td>
<td>1,350</td>
</tr>
<tr>
<td></td>
<td>45–64</td>
<td>304</td>
</tr>
<tr>
<td></td>
<td>≥65</td>
<td>172</td>
</tr>
<tr>
<td>Heart disease or stroke$^{23}$</td>
<td>35–64</td>
<td>533</td>
</tr>
<tr>
<td></td>
<td>≥65</td>
<td>162</td>
</tr>
<tr>
<td>Stroke$^{15}$</td>
<td>45–64</td>
<td>356</td>
</tr>
<tr>
<td>Chronic heart failure$^{19}$</td>
<td>45–64</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>65–74</td>
<td>247</td>
</tr>
<tr>
<td></td>
<td>≥75</td>
<td>228</td>
</tr>
<tr>
<td>Peripheral vascular disease$^{24}$</td>
<td>All ages</td>
<td>560</td>
</tr>
<tr>
<td>Lower limb amputation</td>
<td>All ages$^{37}$</td>
<td>890</td>
</tr>
<tr>
<td></td>
<td>Adjusted$^{38}$</td>
<td>1,258</td>
</tr>
<tr>
<td>Carotid artery disease$^{40}$</td>
<td>45–64</td>
<td>240</td>
</tr>
</tbody>
</table>

The Framingham Heart Study$^{18}$ first demonstrated an increased risk of congestive heart failure (CHF) in patients with diabetes over 20 years ago. A recent investigation$^{19}$ of subjects from the Kaiser Permanente Northwest Division Diabetes Registry reported that CHF was found in 11.8% ($n = 1131$) of type 2 diabetic subjects and 4.5% ($n = 435$) of controls with a mean age of 63 years at baseline. Incident cases of CHF were observed in 7.7% of type 2 diabetic subjects free of CHF at baseline and in 3.4% of controls over 30 months of follow-up. Annual incidence rates increased with age in both groups: 10 cases per 1000 persons with type 2 DM vs 2 cases per 1000 among persons without type 2 DM aged 45–54 years, 25 vs 5 per 1000 in age group 55–64 years, 37 vs 15 per 1000 in age group 65–74 years, and 80 vs 35 per 1000 in subjects over 75 years. From these rates of this large cohort, we calculated a MbR of 500% for the age group 45–64 years, 247% for the age 65–74 years, and 228% for the age over 75 years$^{19}$ (Table 1). Poor glycemic control may be associated with an increased risk of heart failure.$^{20}$ The relationship between exposure to hyperglycemia over time and the risk of macrovascular or microvascular complications in patients with type 2 diabetes has been reported for the 3055 patients followed for 7.9 years in the UK Prospective Diabetes Study.$^{21}$ A comparison of all complications related to diabetes was made by event/person-years in the worst category of patients ($HbA_{1c} ≥ 10\%$) vs those in the low-normal category ($HbA_{1c} < 6\%$). The MbR was calculated as 260% for all complications related to diabetes, 388% for CHF, 152% for fatal or nonfatal myo-
Table 2. Morbidity Ratios (MbR) for Microvascular Complications by Age Groups: Diabetics vs Non-Diabetics Based on Representative Studies Referenced in This Review

<table>
<thead>
<tr>
<th>Microvascular Complications</th>
<th>Age (Years)</th>
<th>Morbidity Ratios MbR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>End Stage Renal Disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973–197558</td>
<td>Adjusted</td>
<td>1,458</td>
</tr>
<tr>
<td>19962</td>
<td>Adjusted</td>
<td>3,287</td>
</tr>
<tr>
<td>Neuropathy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saint Luis VDS 199550</td>
<td>20–44</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>45–64</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>65–74</td>
<td>457</td>
</tr>
<tr>
<td>NHANES II, 198151</td>
<td>35–74</td>
<td>266</td>
</tr>
<tr>
<td>Cataracts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA, 199559</td>
<td>≥65</td>
<td>232</td>
</tr>
<tr>
<td></td>
<td>All adults</td>
<td>679</td>
</tr>
<tr>
<td>Canada23</td>
<td>&gt;65</td>
<td>156</td>
</tr>
<tr>
<td>Glaucoma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA59</td>
<td>All adults</td>
<td>821</td>
</tr>
<tr>
<td>Canada23</td>
<td>≥65</td>
<td>295</td>
</tr>
<tr>
<td></td>
<td>&gt;65</td>
<td>140</td>
</tr>
<tr>
<td>Blindness62</td>
<td>Germany</td>
<td>Adjusted</td>
</tr>
<tr>
<td></td>
<td></td>
<td>517</td>
</tr>
</tbody>
</table>

those with DM, and 3% among those without, for a MbR of 533%. This MbR for heart disease or stroke decreases for age ≥65 years. (Table 1)

Peri-vascular Disease (PVD) and Lower Limb Amputations

The incidence and prevalence of lower extremity peripheral vascular disease (PVD) increases with age in both diabetic and non-diabetic subjects. The prevalence of PVD is about 2%-6% for men and women younger than 50 years of age, rising to >7% in those older than 70 years of age. Worse arterial disease and poorer outcome are reported in patients with DM.

In a Rochester, Minn, population-based cohort of diabetic patients, the cumulative incidence of lower limb PVD measured by pulse deficit was 21.3 per 1000 person-years of diabetes for men and 17.6 per 1000 person-years for women. The actuarially-estimated cumulative incidence of lower limb PVD was 15% at 10 years after the initial diagnosis of diabetes and 45% after 20 years. Using a history of intermittent claudication as the criterion for lower extremity artery disease (LEAD), the Framingham study identified a lower incidence of PVD in diabetic persons in that population (12.6 per 1000 person-years...
Table 4. Disability Ratios (DR) in the United States and Canada. Diabetics vs. Non-Diabetics Based on Representative Studies Referenced in This Review

<table>
<thead>
<tr>
<th></th>
<th>DR (%)</th>
<th>≥1 Disability Days in 2-week Period in the Year</th>
<th>Disability for an Entire 2-week Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA:²⁶</td>
<td></td>
<td>age ≥18 years</td>
<td>217</td>
</tr>
<tr>
<td>Canada:²³</td>
<td></td>
<td>age 35–64 years</td>
<td>209</td>
</tr>
</tbody>
</table>

for men and 8.4 per 1000 person-years for women). For individuals without diabetes in the Framingham population, incidence rates were 3.3 and 1.1 per 1000 person-years for men and women, respectively. We calculated a MbR of 382% for men and 764% for women.

Based on 285,900 diagnoses listed in the hospital discharge records from the 1989–1991 National Hospital Discharge Survey, lower limb PVD was found in ~3% of diabetic hospitalizations vs 0.6% of non-diabetic hospitalizations.²⁴ The MbR was 560%. (Table 1)

The loss of a limb is a frequent complication of DM, the result of diabetic foot problems, such as ulcers and infection. The risk of lower limb amputation is increased up to 15-fold in people with diabetes.²⁸ More than half of all nontraumatic lower limb amputations occur in patients with diagnosed DM. Between 1980 and 1986, the number of DM-related hospital discharges post-lower limb amputations increased from 36,000 to 86,000 per year. Almost 60% of diabetes-related lower limb amputations occurred among patients over 65 years, with an average length of stay of 13.7 days. Lower limb amputations per 1000 persons rose with age. In 1996, the rates among patients over 75 years were more than twice those among persons under age 65. The rate was higher among men than women and among blacks than whites.² Higher mortality rates are reported among patients with DM who have had a lower limb amputation.²⁹,³⁰,³¹ Half of those who had an amputation will require amputation of the remaining limb within 5 years.³² This morbidity results in high medical and rehabilitation costs. About 10% of diabetes-related health care costs are associated with lower limb amputation.³³ The duration of hospital stay has been identified as one of the main determinants of cost associated with lower limb amputation.³⁴ There is a large variation in length of hospital stay varying from 16.0 days in the United States,²⁷ 24.7 days in Australia,²⁸ and 40.8 days in the Netherlands.³³

Amputation rate was determined in 1044 NIDDM patients aged 45–64 years followed for 7 years in Finland.³⁵ The rate of amputation was 6.5% in men and 5.3% in women. High fasting plasma glucose (FPG) at baseline and duration of DM were associated with twice the rate of amputation. Similarly, glycemic control measured at baseline by HbA₁c was an important predictor. A dose-response relationship was found between plasma glucose or HbA₁c and the rate of amputation. The effect of hyperglycemia was seen clearly, even after adjustment for other cardiovascular risk factors. Signs of peripheral neuropathy, bilateral absence of the Achilles tendon reflex as well as vibration sense were also predictors for increased rate of amputation.

In 1989, the NHIS³⁶ determined that the rate of amputation was 10 times higher among diabetic vs non-diabetic individuals aged ≥18 years (2.8% vs 0.29%). In an analysis from Medicare claims for 1996–1997, the yearly rate of major amputations was 3.38/1000 individuals with DM vs 0.38/1000 without DM. We calculated a MbR of 890%. (Table 1)

In a retrospective study³⁸ involving a population of 253,000 inhabitants in eastern Finland, among 477 patients (85 diabetic men, 127 non-diabetic men, 169 diabetic women, and 96 non-diabetic women) followed for 6 years, the annual age-adjusted amputation...
incidence was 349.1/100,000 for diabetic men, 33.9/100,000 for non-diabetic men, 329.4/100,000 for diabetic women, and 17.2/100,000 for non-diabetic women. We calculated a MbR of 1030% in men, 1392% in women, and 1258% after adjustment, comparing incidence rates observed in diabetic patients with those in the non-diabetic population. (Table 1)

Based on records from 3 German hospitals, Trautner and colleagues reported amputation incidence rates standardized to the entire German population of 33.8/100,000 per year for all amputations per total population, 209.2/100,000 for amputations in diabetic individuals per diabetic population, and 9.4/100,000 for amputations in non-diabetic individuals per non-diabetic population. Comparison of the incidence rates of amputation in patients with DM to those without DM gave an MbR of 2225%, as opposed to 619% for the general population.

**Carotid Artery Disease**

Carotid artery disease is also higher in patients with DM than in those without DM. A cross-sectional study in Finland compared data from 10-year follow-up in a cohort of 133 patients aged 45–64 years with NIDDM, and 144 age-matched, non-diabetic controls randomly selected from the general registry. The frequency of carotid atherosclerosis was markedly higher in patients with NIDDM (25.0%) than in non-diabetic subjects (10.4%). The MbR was 240% (Table 1). A similar MbR was calculated from an Italian study comparing the 46% prevalence of carotid atherosclerosis in 54 diabetic subjects to 18% in 54 matched non-diabetic controls. The MbR was 255%.

**Stroke**

Diabetes is a clear risk factor for stroke, particularly ischemic stroke. From prospective studies, relative risk for stroke is 2.5 (95% CI 1.6 to 4.0), possibly because many with DM also suffer from hypertension. Based on the 1990–92 NHIS, the prevalence of persons in the US population who report a medical history of stroke increases with age, from 1.7% of those aged 45–64 years to 8.1% of those aged ≥75 years.

In the Nurses Health Study (116,177 women followed for 8 years), the age-adjusted risk of stroke for diabetic vs non-diabetic women was 4.1 (95% CI 2.8 to 6.1). The Atherosclerosis Risk in Communities (ARIC) study, included more than 12,000 adults aged 45–64 years without cardiovascular disease at baseline and followed them for 6–8 years for ischemic stroke occurrence. In ARIC, the incidence rates per 1000 person-years (adjusted for age, race and sex) were 5.38 for diabetic subjects vs 1.51 for non-diabetics. We calculated an MbR of 356%. (Table 1)

In Canada, an increased risk of stroke has been reported in a study at Kahnawake (Quebec), a Mohawk community near Montreal. Thirteen percent of people with DM had had stroke vs 3% of a comparable group without DM with an MbR of 433%. This same study found that the risk of macrovascular disease was 6 times higher among people with diabetes. This ratio was comparable to that in the nonaboriginal population.

**Neuropathy**

Neuropathy is a common complication of diabetes, affecting 60%-70% of patients. Distal symmetrical polyneuropathy is the most common type. Neuropathy is the most common diabetic complication in developed countries of the world, leading to high morbidity and mortality, and resulting in a huge economic burden for diabetes care.

In the Rochester Diabetic Neuropathy Study, the prevalence was 60% for any neuropathy, 47% for distal polyneuropathy, 34% for carpal tunnel syndrome, and 5% for autonomic neuropathy. The frequency distribution by type of neuropathy and the severity of distal neuropathy were similar for insulin-independent diabetes mellitus (IDDM) and NIDDM.

In the San Luis Valley Diabetes Study, def-
inite neuropathy was found in 28% of Hispanic and white patients with NIDDM. The prevalence of distal symmetrical neuropathy increased from 17% at 0–4 years of NIDDM duration to 50% at ≥15 years duration. Neuropathy rates were approximately 5 times higher in those with NIDDM compared to non-diabetic subjects. The prevalence of neuropathy in subjects with DM vs controls with a normal glucose tolerance test by age group was 10% vs 1% at age 20–44 years, 28% vs 4% at age 45–64 years, and 32% vs 7% at age 65–74 years. Comparison of these rates gave MbRs of 1000%, 700%, and 457% for these age groups, respectively.

In the 1989 NHIS, the prevalence of sensory neuropathy symptoms was 38% in NIDDM subjects vs 10% in those without diabetes. This prevalence increased similarly in men and women with the duration of diabetes. The MbR was 380% when comparing these rates. The absence of knee and/or ankle jerks was ascertained in the National Health and Nutrition Examination Survey II. Among all persons with diabetes aged 35–74 years, the absence of 1 or both reflexes was noted in 12.5%, compared to 4.7% in subjects without diabetes. The MbR of 266% when comparing patients with a medical history of DM to those without DM. (Table 2) Intensive treatment of diabetes with near-normalization of glycemia reduced the 5-year prevalence of neuropathy by 60%–70%, compared with the conventional treatment group.52

Nephropathy and Renal Complications

According to the US Renal Data System, in the past 2 decades there has been a continual increase in the incidence of end-stage renal disease (ESRD) among diabetics, predominantly among those with type 2 diabetes. The proportion of patients with both ESRD and DM rose from 27% to 36% between 1982–1992. Both the prevalence and incidence of ESRD are approximately twice what they were 10 years ago.54

Statistics from the Canadian Organ Replacement Register indicate an increase in the proportion of patients with newly-diagnosed kidney failure who also have diabetes, from 16% in 1981 to 28% in 1996. A similar trend has occurred in other developed countries as well, making ESRD in patients with type 2 diabetes a medical problem of worldwide dimension.56

In the United States, DM is the leading cause of ESRD and kidney failure requiring dialysis or transplantation. It accounts for approximately 40% of all new cases. The number of persons who began treatment for ESRD attributable to diabetes (ESRD-DM) increased from 6981 in 1984 to 31,647 in 1996. Between 1984 and 1996, the age-adjusted incidence of ESRD-DM treatment per 100,000 persons with DM rose by 200%, from 117.4 to 378.1. Among both blacks and whites, the relative increase was also greater than 200%. From 1982 through 1986, treatment for ESRD related to diabetes increased more than 10% each year. In 1996 in the United States, the age-adjusted rate of initiation of treatment for ESRD related to diabetes was 11.5 per 100,000 population, but rose to 378.1 per 100,000 in diabetics. Comparison of these rates resulted in an MbR of 3287%. (Table 2)

The Multiple Risk Factor Intervention Trial screened 332,544 men aged 35–57 years from 18 US cities in 1973 to 1975. Over an average follow-up of 16 years, there were 136 cases of ESRD in 5147 diabetic men and 678 cases in 327,397 non-diabetic men. The age-adjusted incidence of all-cause ESRD in diabetic men was 199.8 per 100,000 person-years compared with 13.7 per 100,000 person-years in their non-diabetic counterparts, with an MbR of 1458%.

Ocular Complications

Retinopathy, cataracts and glaucoma are 3 complications of DM that may lead to blindness. An estimated 97% of insulin-taking and 80% of non-insulin-taking persons who have had diabetes for ≥15 years have retinopathy. Diabetic retinopathy is a highly specific microvascular complication of diabetes; its
prevalence is directly related to the duration of diabetes. The 2000 ADA position statement indicates that vision-threatening retinopathy does not occur in patients with type 1 diabetes during the first 3- to 5-year duration, and that nearly all patients with type 1 diabetes have retinopathy after a 20-year duration of diabetes. Diabetic retinopathy is estimated to be the most frequent cause of new cases of blindness in the United States among adults aged 20–74 years.

Significantly higher rates of vision problems are reported in Canadians over 65 years with DM than those of the same age without DM. Cataracts occur in 21.9% of DM subjects and in 14% of the general population. Glaucoma affects 7% of the DM and 5% of the general population. Vision problems that cannot be corrected and total vision loss occur in 9% of patients with DM vs 5% of persons without the disease. The MbR is 156% for cataracts, 140% for glaucoma, and 180% for vision problems or vision loss, when comparing rates in diabetic and non-diabetic populations.

The 1989 US prevalence of self-reported cataracts in all adults (≥18 years) was 22.42% in those with DM vs 3.30% in controls without DM. Glaucoma was 6.98% vs 0.85%, and trouble seeing was 13.72% vs 3.58%. The MbR was 679% for cataracts, 821% for glaucoma, and 383% for trouble seeing. The rates for age ≥65 years were 38.37% for cataracts, 821% for glaucoma, and 383% for trouble seeing. The MbRs for this age category were 232% for cataracts, 295% for glaucoma and 231% for trouble seeing.

Incidence rates of blindness in the diabetic population compared to the non-diabetic population were collected in the district of Wuttemberg-Hohenzollern, Germany, between 1990 and 1993. Standardized to the German population, the incidence rates (per 100,000 person-years) were 13.5 in the general population, 60.0 in the diabetic population, and 11.6 in the non-diabetic population. Comparing incidence rates in the diabetic population with the non-diabetic population, the MbR was 517%.

**RISK OF HOSPITALIZATION**

DM is usually diagnosed and treated on an outpatient basis, and hence, tends to be poorly represented in hospital discharge records. Furthermore, people with DM are usually admitted to the hospital because of related complications. Data from the Centers for Disease Control and Prevention indicate that in 1996 the number of hospital discharges with diabetes as the first-listed diagnosis (all ages) was 503,000, with an average length of stay of 6.3 days. The age-adjusted rate of emergency department visits was 14.1 per 100 persons with DM. Based on the 1989 NHIS, 23.8% of all adults with DM vs 7.8% of those without DM reported being hospitalized at least once in the previous year. We calculated a hospitalization ratio (HR) of 305% (ie, for all adults, persons with DM are 3 times more likely to report being hospitalized in the previous year than persons without DM). The HR was 411% for age 18–44 years, 239% for age 45–64 years, 168% for age 65–74 years, and 184% for age ≥75 years.

In Canada, approximately 34,000 hospital discharges were attributable to DM in 1995. This figure represents over 400,000 hospital days for DM. The age-standardized rates were 112 hospital discharges per 100,000 population, and 1368 hospital days per 100,000 population. In 1996–1997, self-reported overnight stay in hospital, nursing home or convalescent home in the previous year in Canada was: 16.2% in persons with DM aged 35–64 years vs 7.5% in persons without DM, and 23.9% vs 13.9% in persons over age 65 years. The HR was 216% and 172% in these age groups, respectively.

In a retrospective cohort study in Tayside, Scotland, during 1995, in 366,849 people registered with general practitioners, the length of stay was highest for patients with DM. This group had approximately double the risk of admission, due to a higher risk of
neurological, cardiovascular, renal and ophthalmic hospitalization compared to people without DM. Approximately 24% of all study subjects with DM had at least 1 hospital admission, compared to 12% of the non-diabetic population. We calculated an HR of 200%.

In a register-based linkage study comparing hospital use among diabetic and non-diabetic populations in Finland, 50.7% of patients with DM had at least 1 hospital stay for any cause in the year, compared to 12.4% of the non-diabetic population. The HR was 409%. Table 3 summarizes hospitalization ratios calculated from these studies.

**RISK OF DISABILITY**

Disability affects large numbers of persons with DM in the United States with estimates ranging from 20% to 50% of the diabetic population. The rates of disability are substantially higher among persons with DM than among subjects without this disease. The consequences of disability among persons with DM include increased use of health care services, unemployment, work absenteeism, and decreased quality of life.

Chronic diseases, including diabetes, are strongly linked with reported activity limitation in the NHIS. In 1983–1985, DM was the 11th most common condition cited as the main cause of activity limitation in the United States, accounting for 2.7% of all reported cases. When considered as the contributing cause of activity limitation, it was the 6th most frequent condition cited, explaining 6.5% of all cases.

In 1989 the age-standardized percent of persons aged ≥18 years reporting any restricted activity days in the previous 2 weeks was 22.4% in individuals with NIDDM, 21.3% in individuals with IDDM vs 10.3% in subjects without DM. The disability ratio, calculated as the ratio in subjects with NIDDM to those without DM, was 217%. Absenteeism associated with diabetes was also assessed in the 1989 NHIS. Measured as the number of work-loss days in the previous 2 weeks, it was higher among both NIDDM and IDDM respondents, compared with the non-diabetic population: 11.8 vs 6.9 at age 18–44 years. The DR was 184% when comparing NIDDM respondents with the non-diabetic population.

In 1994, approximately 42% of individuals aged 18–69 years with diabetes reported being unable to work or being limited in the kind or amount of work activity they could do, and approximately 33% were sufficiently disabled to be completely out of the workforce.

Work disability was reported by 25.6% of individuals with diabetes, compared with 7.8% of those without diabetes. Work-loss days per year were 5.9 in men and 5.4 in women with DM vs 3.4 in men and 3.8 in women without diabetes, according to the National Medical Expenditures Survey. From these results, the DR for disability in individuals with diabetes vs those without diabetes was 328%.

In Canada, among people of working age (35–64 years), 23% of those with DM reported 1 or more disability days (in bed or with restricted activities) in a 2-week period, compared to 11% of those without DM. The DR was 209%. Disability for an entire 2-week period was reported by 9.3% of people with DM compared to 2.9% of people without DM. The DR was 320%. Of those who reported at least 1 disability day in the previous 2-week period, those with DM had an average of 9 disability days, compared to an average of 6 days among those without DM. A prospective, population-based cohort study screened individuals of working age (18–64 years) in Manitoba found 25,554 persons without diabetes and 608 with diabetes. Diabetic individuals with complications were twice as likely not to be in the labor force compared to non-diabetic individuals (OR 2.07, 95% CI 1.49–2.87).

Disability in persons with DM is influenced by a number of demographic and diabetes-related factors. Impairments reported by persons with DM increase with age. At age 18–44 years, 45% report activity limitation; at age 45–64 years, 55% report activity limita-
tion; and at age $\geq 65$ years, 60% report activity limitation. Disability is more common in minority groups. Persons with NIDDM, particularly those using insulin, appear to be more affected than those with IDDM. The presence of late complications of DM seems to be a major determinant of disability. Table 4 summarizes the DR calculated from these studies.

CONCLUSIONS

Diabetics have higher rates of morbid events, hospitalization and disability days than non-diabetic persons.

Morbidity ratios (MbR) and hospitalization ratios (HR) should be carefully reviewed according to age when underwriting private health insurance.

Disability ratios (DR), MbRs and HRs should also be carefully reviewed when underwriting disability insurance for diabetics.

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