MORTALITY STUDY OF POLICIES ON INSURED LIVES WITH DIABETES MELLITUS KNOWN AT TIME OF ISSUE

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ABSTRACT

Background – This is an Impairment Study Capture System (ISCS) study of contemporary Diabetes Mellitus mortality among insured lives. Because the diagnosis and treatment of diabetes has changed during the last 15 years, many applicants may be expected to exhibit more favorable outcomes than in the past. The study covers policy-years durational experience extending to only 10 years.

Methods – We analyzed the total mortality experience of 41,972 insurance policies. The policies were issued at standard or substandard premium rates between 1989 and 2002 policy anniversaries. The number of policies terminated by death (actual deaths) is compared with expected deaths using the 2001 Valuation Basic Table (2001 VBT). Main outcome measures are expressed as mortality ratios (MR %) and excess death rates/1000 (EDR/M). Poisson Confidence Intervals are used to test the statistical significance of mortality ratios at the 95% confidence limit.

Results

– The total experience includes: of 103,104 policy-years exposure: males; 57,888 policy-years (56%) and females; 45,216 policy-years (44%). There were 495 policy-deaths – 284 male and 211 female.

Substandard risks represented the majority of the total exposure, 76,658 policy-years in both sexes combined (male 56% and female 44%). The mean duration of substandard exposure was 2.3 years.

–Total mortality for all insured age-groups and risk categories combined was 188%.

–No significant difference in relative mortality by sex was noted. For both sexes' excess deaths per 1000 increased with advancing age.

–No significant difference in relative mortality between nonsmokers and smokers was noted.

–The mortality ratios for policies rated standard had confidence intervals that were consistent with 100% of the 2001 VBT.

– The mortality ratios for policies rated substandard had confidence intervals that were above 100% of the 2001 VBT.

– For duration from diagnosis intervals 1-2 and 3-6, the mortality ratios were not significantly different from the 100% of the 2001 VBT. For all of the higher duration intervals, the mortality ratios were significantly higher than the 100% of the 2001 VBT.

– For substandard policies by degree of rating, the upper limit of the confidence intervals increased as the rating ranges of the policies increased.

– For ages at diagnosis 0-39, 40-49, 50-59 and 60-69, the mortality ratios had confidence intervals that were above 100% of the 2001 VBT.

– Treatment type (both sexes combined) – Cases treated by diet alone produced the most favorable mortality ratio of 161%. Diet plus oral agent treated cases exhibited a higher mortality ratio of 195 %. Diet plus insulin treated individuals had the highest mortality ratio of 224 %.

Conclusion – A clinical diagnosis of diabetes continues to demonstrate evidence of increased mortality in insured individuals. However, the risk in the early policy durations appear to have lessened for insured lives compared to that measured in earlier published studies.

Underwriting risk appraisal effectively categorizes diabetic mortality risks. The diabetic risks that underwriters categorized as standard and substandard showed early duration mortality consistent with standard risks, and substandard risks, respectively. Furthermore, the substandard classes assigned to policies were consistent with the mortality results.

The lack of significant differences in the mortality ratios between males and females as well as between nonsmokers and smokers indicate that the early duration variations by gender and smoking status in the 2001 VBT account for these differences in early duration diabetes mortality. Subsequent follow-up studies containing longer durations may show these differences emerging.

Results must be interpreted with caution because of the small data set, limited number of ISCS participating companies and policy-years durational experience extending to only 10 years.

INTRODUCTION

Diabetes Mellitus is a chronic and complex multisystem metabolic/endocrine disease characterized by inappropriate hyperglycemia and impaired metabolism of sugar and other energy yielding foods. It is genetically determined and linked to defects in insulin secretion, insulin utilization, or both. Diabetes-related mortality is frequently associated with multisystem pathologies affecting the cardiovascular, cerebrovascular and peripheral vascular systems, renal and central nervous system.

The importance of this disease to the insurance industry and others interested in diabetes follow-up studies is emphasized by the recent increase in the incidence of Type II Diabetes Mellitus linked to obesity and lack of physical activity[1, 2, 3]. Now the sixth leading cause of death in America, diabetes is responsible for over 200,000 deaths each year[4].

Recognizing that diabetes age-adjusted death rates in the general population have increased by about 30% in the past 12 years[5] and that diabetes is routinely encountered by life underwriters in insurance applications, the Mortality and Morbidity Liaison Committee (MMLC) deemed it highly important to examine current diabetes-related mortality trends, patterns and outcomes in the insured population.

Diabetes Mellitus classification and risk factors[6] as well as the new and more stringent 1997 World Health Organization (WHO) clinical and laboratory definitions and diagnostic criteria for diabetes have been cited elsewhere[7]. Detailed reviews are also available from the *Journal of Insurance Medicine* [8, 9] and other publications.[10, 11, 12].

METHODS

Analysis was performed on the total mortality experience of 41,972 insured lives submitted by 17 participating Impairment Study Capture System (ISCS) insurance companies that were issued at standard or substandard premium rates between 1989 and 2002 policy anniversaries and followed for up to the first 10 annual policy durations. (See Appendix A for ISCS contributing companies). Data demographics on insured lives include age and sex-specific, number of policies issued, exposure in policy years, observed deaths, average size claim amount, average policy amount, and issue age grouping. Data demographic information may be reviewed in Appendix B.

Observed deaths are based on the number of policies terminated by a death claim. Consequently, each policy death provides information about the outcome of a different underwriting event. However, an individual with multiple policies could lead to multiple observed deaths in a study. An analysis of the Diabetes Mellitus death claims indicate a maximum of 9 death claims out of a total of 495 death claims (1.8%) could have been counted more than once.

Review of the data indicated that all cases had a diabetes code. In the first section of Table 1, By Rating and Smoking Status, standard and substandard policies are presented. In the remaining sections of Table 1, only substandard policies are presented.

In Table 2 and Table 3, only substandard policies are presented. The substandard cases without codes for other medical or nonmedical impairments are called single impairment. The substandard cases with codes for other medical or nonmedical impairments are called multiple impairment. The heading of each section of these tables clearly indicate whether single or multiple impairment cases are combined or presented separately.

Based on the range of years indicated by the time-stamp on the code for the diabetes impairment, the number of years diagnosis occurred before application was assigned a value of 1 within the first year, 2 within the second year, 4 within the third-fifth year, 8 within the sixth-tenth year, 15 if it occurred more than 10 years prior and if the time in the past was indefinite. Diabetes diagnosis age was coded as the issue age minus the number of years diagnosis occurred before application. Duration from diagnosis is the issue age minus diabetes diagnosis age plus duration.

Basis of Expected Deaths – Expected deaths are based on the 2001 Valuation Basic Tables (2001 VBT) created by the Society of Actuaries (SOA) Individual Life Insurance Valuation Mortality Research Task Force (Task Force) and published in its November 2001 report. As that report relates, the Task Force took the experience tables that were fit to the underlying experience data and created a smoothed valuation table split by gender and smoking status. The 1990-95 experience tables include experience from individually underwritten life insurance policies for the period 1990-1995 that was formulated into composite tables (nonsmoker, smoker and unknown smoker combined) that varied by gender. The Task Force added data at older issue ages that was provided by Bragg Associates and data for males in ultimate durations from the Veterans Administration's National Service Life Insurance program to create the 2001 VBT's male and female composite tables. Based on existing studies, the Task Force developed factors to separate the composite tables into the 2001 VBT male and female tables for nonsmokers and smokers. The 2001 VBT includes issue ages from 0 to 99 with select durations 1 to 25 and ultimate factors.

Based on the gender and smoking status of the insured, the 2001 VBT mortality rates are used to calculate expected deaths. If the insured is a nonsmoker, the nonsmoker version of the 2001 VBT is used. If the insured is a smoker, the smoker version of the 2001 VBT is used. If the smoking status of the insured is unknown, the composite version of the 2001 VBT is used. Caution needs to be used in interpreting results of the unknown smoker. If

the proportion of the unknown smokers is in fact heavily weighted with smokers, the expected deaths based on the composite table will understate the number of deaths.

Expected deaths based on 100% of the 2001 VBT are used as the basis for comparison for statistical significance evaluation. The reader should be aware that the actual deaths vary by underwriting classification and over time. Mortality experience of the preferred class will be less than 100% of the 2001 VBT. The SOA's 2000-2001 Individual Life Experience Report, the overall experience of preferred and residual standard classes was 89% of the 2001 VBT for policy anniversaries beginning in 1996 and ending in 2001. The mortality experience of substandard classes will be greater than 100% of the 2001 VBT. Additionally, overall mortality experience will tend, and has historically tended, to improve over time.

Statistical Significance Evaluation[10, 13, 15]

Poisson confidence intervals are calculated around mortality ratios (MR) based on the number of observed policy deaths relative to VBT expected deaths. The null hypothesis is that the actual deaths are the same as expected deaths based on 100% of the 2001 VBT. To achieve statistical significance for a given mortality ratio, the confidence interval must exclude 100%. A statistically significant result can be modified by using a different mortality basis for that business other than 100% of the 2001 VBT. The 95% confidence interval for the mortality ratios was calculated using the Byar approximation of the Poisson confidence intervals.

RESULTS

Exposure

Policy-years exposure by rating category, smoking status and single and multiple impairments for both sexes combined are presented in the Chart below.

Policy-Years Exposure in Both Sexes Combined

	Exposure Policy-years (*E*)	**Percent** Exposure (%)
Diabetes Only	**38,472**	**37**
Standard rating	11,849	31
Substandard rating	26,623	69
Diabetes with Another Impairment	**64,632**	**63**
Standard rating	14,597	23
Substandard rating	50,005	77
Diabetes Alone or with Another Impairment	**103,104**	**100**
Standard rating	26,446	26
Substandard rating	76,658	74
Nonsmoker	64,291	63
Smoker	13,744	13
Unknown smoker status	25,069	24

It is noteworthy that 74% of the total exposure of 103,104 policy-years was represented by substandard risks (76,658 policy-years). Smoker and unknown smoking status combined represented 37% of the total exposure. Mean duration of total policy exposure is 2.46 years and mean duration of substandard risk exposure is 2.30 years.

1. Mortality by Rating and Smoker Status – Table 1
(All ages, durations, treatments and single and multiple impairments combined)

No significant difference in relative mortality between nonsmokers and smokers was noted. The lack of significant differences in the mortality ratios between males and females as well as between nonsmokers and smokers indicate that the early duration variations by gender and smoking status in the 2001 VBT account for these differences in early duration diabetes mortality. Subsequent follow-up studies containing longer durations may show these differences emerging.

The mortality ratios for standard policies are 128% for males, 139% for females and 132% for males and females combined. For males, the results are not statistically significant. For females and both genders combined the results are statistically significant. These results are consistent with diabetics rated standard that are in the classification of residual standard.

The mortality ratios for policies rated substandard had confidence intervals that are above 100% of the 2001 VBT. The diabetic risks that underwriters categorized as substandard showed mortality consistent with substandard risks.

2. Substandard Mortality by Policy-Issue Age – Table 1
(Includes only substandard policy issues with all durational intervals, single and multiple impairments and all smoker status [smoker, nonsmoker, and unknown] combined).

Issue ages include the following age groups: 0-39, 40-49, 50-59, 60-69, and 70 up.

When split by policy-issue age, almost all of the substandard policies show mortality that is significantly above 100% of the 2001 VBT.

There is a trend towards higher mortality in younger age bands and lower risk in the oldest group, but this does not achieve statistical significance. This may be due to the fact that the longest credible policy duration studied was 10.

3. Substandard Mortality by Policy-Year Durational Intervals – Table 1
(Substandard; all issue ages combined; smoker, nonsmoker, unknown and single and multiple impairments combined).

Policy-year durational intervals include: 1-2, 3-5, and 6-10.

There is no statistically significant trend in this study among the policy-year durational intervals in the early policy durations.

4. Substandard Mortality by Duration from Diagnosis – Table 1
(Substandard; all diagnostic and issue ages combined; smoker, nonsmoker, unknown and single and multiple impairments combined).

Durational intervals are: 1-2, 3-5, 6-10, 11-15, and 16-25 years.

For duration intervals 1-2 and 3-6, the mortality ratios are not significantly different from 100% of the 2001 VBT. For all of the higher duration intervals, the mortality ratios are significantly higher than 100% of the 2001 VBT..

5. Mortality by Degree of Rating – Table 2
(All ages, durations and treatments combined; smoker, nonsmoker and unknown combined).

For substandard policies by degree of rating, the upper limit of the confidence intervals increased as the rating ranges of the policies increased.

For single and multiple impairments combined, all the breakdowns had mortality ratios significantly higher than the 100% of the 2001 VBT.

6. Substandard Mortality by Age at Diagnosis – Table 2
(Substandard, all issue ages and durations combined; smoker, nonsmoker, unknown combined; single and multiple impairments and all durations to 16-25 years combined).

For males by diagnostic age, the results are significant except for diagnostic ages 80 and up. For females by diagnostic age, the results are significant except for diagnostic ages 40-49 and diagnostic ages 80 and up. For males and females combined, all results are significant. The increased significance for males and females combined is due to combined experience making the confidence interval narrower.

7. Substandard Mortality by Type of Treatment – Table 3
(Substandard, all ages and durations combined; smoker, nonsmoker, unknown combined)

For treatment type with both sexes combined, increasing mortality was associated with more aggressive types of treatment:

- Cases treated by diet alone produced the most favorable mortality ratio of 161%.
- Diet plus oral agent treated cases exhibited a higher mortality ratio of 195 %.
- Diet plus insulin treated individuals had the highest mortality ratio of 224 %.

DISCUSSION

Total Mortality – Table 1
The overall mortality ratio (188%) for the combined study group is increased, but is less than that noted in previously reported insured lives studies. The precise reasons for the improvement are unclear from this data but may include:

-Improved comprehensive, multidisciplinary case management.
-Improvements in diabetes preventive care measures.

-More aggressive glycemic control as measured by hemoglobin A1C.
-Positive life style improvements and secondary preventive measures.
-Use of newer and better medications (statins, ACE inhibitors, etc.) for the prevention and management of complications.
-Web-based (evidence-based) information and availability of clinical practice guidelines.
- Average duration of follow-up is shorter than the average duration of follow-up in earlier insured lives studies.
-Probably most importantly, revision of the disease definition leading to the insuring of applicants with less severe Diabetes Mellitus than in the past.

In general, many categories did not show a significant difference between factors (their confidence intervals overlapped). This may very well be due to the relatively small size of this study and the short duration of follow-up, both of which may tend to mitigate mortality rates. Nevertheless, several interesting *patterns* of mortality can be observed that might achieve statistical significance given longer durations and increased exposure.

Substandard Mortality By Policy-Issue Age – Table 1 illustrates the trend in mortality seen with issue age. Although the values do not reach statistical significance, the pattern is similar to that seen with age of diagnosis. There is higher relative mortality in younger ages, a fairly constant risk in the middle age bands, and lower risk in the older cohort.

Substandard Mortality By Duration from Diagnosis – Table 1. Mortality was modestly and, in some cases not significantly, increased in early durations. In the later durational years relative risk increased with an upward trend. The difference between the various durational bands is statistically significant. This pattern of increasing mortality with time is a well-recognized phenomenon and is likely related to the occurrence of diabetic complications, many of which become evident only after years of exposure.

Mortality By Degree of Rating – The results of this study indicate that diabetes remains a disease with significant mortality risk in most cases. More importantly, the results further illustrate that the current insurance industry approach to evaluating the mortality outcomes in this disease are accurate and adequately approximate the actual experience encountered

by insurers. These results hold true for both the smoker and nonsmoker groups. The fact that the mortality ratios for smokers in this study may be lower than those seen in previous publications in the literature is likely due to the fact that the VBT table used for comparative mortality calculations adjusts for smoking status.

Substandard Mortality By Age at Diagnosis – Table 2. As noted above, despite the lack of statistical significance in comparing age bands in this data, the pattern of relative mortality with age in diabetes is one of greater risk in younger individuals. Insured lives rated substandard who were diagnosed with diabetes before age 40 had a higher total mean mortality risk for all durations combined than later ages at diagnosis. There are several possible reasons for this pattern. Type I, insulin dependent, disease is more common in younger individuals. In addition, a younger age of onset provides a greater duration of exposure for serious complications to develop. Finally, expected death rates are lower in the lower age ranges thus increasing the relative mortality risk associated with any number of excess deaths.

Conversely, the relative risk is lower in the oldest cohort and, in fact, may be only marginally greater than standard rates. However, the lower relative mortality does not mean that diabetes is insignificant in this age group. While the relative risk is diminished the absolute risk as evidenced by the excess death rates is significant. In addition, the overall burden of disease or the number of individuals affected in the population is greater in the older group, indicating a substantial overall mortality risk in both the general and insurance populations.

Substandard Mortality by Type of Treatment – Table 3. Overall, and in most age bands, mortality ratios vary by the type of treatment from lowest with diet alone to highest with diet and insulin. The progression of mortality from diet to oral to insulin is statistically significant. There are several potential reasons for this pattern. In many ways the type of treatment is associated with other factors driving mortality risk. Diet controlled diabetes is more likely to be newer onset or milder disease. Insulin treatment, on the other hand, is associated with younger age of onset, insulin deficiency or poor control/compliance. That all insulin treated cells do not show the highest mortality ratios may be the result of some of the nuances of the insurance process. Since the lives here represent policies in force, the insureds studied represent the better risks associated with insulin treatment. The better risks, those accepted for insurance at lower rates, are more likely to accept the offered policy and appear in the study. Others with poorer control are more likely to be declined or to not accept a high substandard offer.

Comparison with Earlier Studies[11, 12, 14]

The study design of the 1983 Single Medical Impairment Study (SMIS) provides data on single medical impairments by number of policies followed for 25 years. It deals with the mortality experience between 1962 and 1977 anniversaries on nearly 2,400,000 policies issued at standard or substandard premium rates. The Multiple Medical Impairment Study (MMIS) is a follow-up study of mortality in insured lives from the same years as the SMIS with one or more impairments in addition to diabetes. This enables the determination of mortality consequences by the nature and severity of the additional impairments. These studies do not readily allow direct comparison with the current ISCS data in most risk categories because of differing study designs, much longer periods of exposure, more liberal diabetes definitions, changes in the range of residual standard expectations by participating companies, and differences in treatment and clinical follow-up. In addition, consideration was not given to smoking status.

The Lincoln National Reinsurance Company 1995 study[14] focused on policies issued from 1965 through 1984 that were followed to death, lapse or policy anniversary in 1991. The cases included all diabetics under treatment by diet alone, diet and oral agent, or diet plus insulin. Comparison with this study is difficult for several reasons: various subgroups were analyzed in the Lincoln study and these may not correspond to our groups, the time span of the Lincoln study was greater and duration of follow-up was longer, a factor that may have a significant influence on complications and death rates, a different expected basis was used, and, finally, the era studied and, the types of treatments available for the disease and its complications were significantly different.

Conclusions

- Long-term mortality rates in insured lives have improved in the modern era, but Diabetes Mellitus still remains a significant risk to life.
- Underwriting risk selection effectively uses current risk appraisal processes that include underwriting tools such as blood work and review of medical records.
- Even though standard issue diabetics have mortality ratios in excess of 100, all the 95% confidence bands include 100. This means that standard issue policies are within residual standard in the early policy durations studied. Substandard issue diabetics demonstrate an excess mortality consistent with the underwriting evaluation.
- In early policy durations, there is no statistically significant increasing trend in mortality among policy-year durational intervals. Subsequent follow-up studies containing longer durations may show these differences emerging due to increasing morbidity of diabetes over time.
- For the duration intervals from diagnosis 1–2, and 3–5 years, the mortality ratios are not significantly different from the 100% of the 2001 VBT. For all other durations, the mortality ratios are significantly higher.
- Policy-issue age groupings had a pattern of mortality risk consistent with that seen in earlier studies, but the results are not statistically significant. Insureds diagnosed with diabetes prior to age 69 had mortality ratios significantly higher than the 100% of the 2001 VBT. Those insureds age 70 and over are consistent with the 100% of the 2001

VBT when studied by gender, but were higher than the 100% of the 2001 VBT when males and females were combined.

- For both genders combined, a pattern of increasing mortality by treatment type was associated with more aggressive treatment of the diabetes.

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List of Tables

List of Appendices

APPENDIX A:

ISCS COMPANIES CONTRIBUTING TO DIABETES MELLITUS STUDY

- Allstate
- Canada Life
- Great-West Life & Annuity Insurance Company
- Guardian Life Insurance Company
- Lincoln National Life Insurance Company
- Manulife Financial
- MONY Life Insurance Company
- Northwestern Mutual Life Insurance Company
- State Farm Insurance
- Sun Life Financial
- The Hartford
- Thrivent Financial for Lutherans
- Western and Southern Financial Group
- Woodmen of the World Life Insurance Society

APPENDIX B: DATA DEMOGRAPHICS ON INSURED LIVES

The total number of policies issued between 1989 and 2002 was 41,972 (23,268 males and 18,704 females). The potential exposure period is relatively short at 13 years. The report covers the first 10 durations. Total exposure in policy-years was 103,104 with an average policy-exposure of 2.46 years.

Gender	Avg. Issue Age-years	No. of Policies	Percent (%)	Exposure Policy-yrs	Observed Policy-Deaths
Male	48.7	23,268	55	57,888	284
Female	51.4	18,704	45	45,216	211
Combined	49.9	41,972		103,104	495

Gender	Issue Age Grouping	Avg. Policy Amount ($)	Policies Issued	Avg. Claim Amount ($)
Male	<40 years	100,115	5,468	67,821
	40-49	117,341	6,560	84,298
	50-59	116,206	6,146	56,757
	60-69	106,027	3,952	36,660
	70 up	116,468	1,142	137,922
	Total	111,028	23,268	68,461
Female	<40	67,827	3,933	54,217
	40-49	57,049	4,128	53,706
	50-59	49,602	4,391	22,472
	60-69	35,207	4,425	17,756
	70 up	39,366	1,827	21,458
	Total	50,671	18,704	23,933

Number of Policies	
Standard risk	8,657
Substandard risk	33,315
Total	41,972

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