Chapter 8
Analyzing the Relationship between Diagnosis and the Cost of Diabetic Patients

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ABSTRACT
The purpose of this study is to examine the relationship between the diagnosis and the cost of patient care for those with diabetes in Medicare. In this analysis, the author used data sets about outpatient claim, inpatient claim as well as beneficiary demography information for the year 2004, all of which were taken from the Chronic Condition Data Warehouse provided by the Centers for Medicare and Medicaid. The author analyzed the cases for diabetic inpatients and outpatients by different methods. For outpatient analysis, exploratory data analysis and linear models were used. The results show that the total charges for diagnoses are reduced considerably for payment. The distribution of the total charges follows a Gamma distribution. The output of the generalized linear model demonstrates that only 15 out of the top 20 primary treatments for charges are statistically significant to the expenditures on outpatients.

BACKGROUND
Information about Diabetes and its Co-Morbid Diseases
Diabetes is a devastating disease that greatly impacts long-term care. In recent years, diabetes has become a serious problem. According to the Centers for Disease Control and Prevention (CDC) (2007), 23.6 million children and adults had diabetes in the US in 2007, and 12.2 million are over 60 years old. Diabetes can lead to many complications such as heart disease, renal failure, high blood pressure and anemia. Statistics carried out by the American Diabetes Association showed that heart disease strikes people with diabetes twice as often as people without diabetes. Diabetes is the leading cause of new cases of blindness in people ages 20-74 and the primary cause of end-stage renal disease. The CDC also states that about 60% to 70% of people with diabetes have mild to severe forms of nervous system damage, and severe forms of diabetic
nerve disease are a major contributing cause of lower-extremity amputations. In addition, the co-morbidities often suffered by patients with diabetes can affect each other. For example, diabetes is the leading cause of renal failure. The National Institute of Diabetes and Digestive and Kidney Diseases study (2008) showed that nearly 24 million people in the United States have diabetes; the Annual Data Report supported by United States Renal Data System (2007) illustrated that nearly 180,000 people are living with kidney failure as a result of diabetes. Diabetic nephropathy likely contributes to the development of anemia in patients with diabetes. Anemia often develops early in the course of chronic kidney disease in patients with diabetes and also contributes to the high incidence of cardiovascular disease observed in diabetic patients.

Each year, it takes a large amount of resources to treat diabetes and its complications including organ dysfunctions and neurological disorders. (See Table 1). According to the American Diabetes Association (2007), the total annual economic cost of diabetes in 2007 was estimated to be $174 billion; medical expenditures totaled $116 billion, including $27 billion for diabetes care and $58 billion for chronic diabetes-related complications. Therefore, it is very essential to control diabetes. Among all the measures to control diabetes, blood glucose monitoring is the best. The Diabetes Control and Complications Trial funded by the National Institutes of Health reported in 1993 that intensive glucose control prevents or delays the eye, nerve and kidney complications of type I diabetes (as cited in the Glucose Control Cuts Risk of Heart Disease in Type 1 Diabetes, 2005); and the DCCT/EDIC study (2005), which illustrated that intensive glucose control lowers the risk of heart disease and stroke by about 50 percent in people with type I diabetes. However, renal failure treatment is expensive since the treatment includes dialysis, an artificial blood-cleaning process, or transplantation to receive a healthy kidney from a donor. Since the expenditures for the treatment of renal failure account for 30 per cent of the costs of the treatment of diabetes, it is essential to find and examine the factors that impact on renal failure in order to reduce the total charges of diabetes treatment.

**Information about the Data**

Two data sets about claim information were used in this analysis: the outpatient_base_claims with 2,030,078 records and the inpatients_base_claims recorded 244,299 items. Since both of them do not cover demography information, the beneficiary_summary_file was needed. They were all

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**Table 1. Health care expenditures attributed to diabetes (in millions of dollars) (Anonymous-ADA, 2008)**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Diabetes</th>
<th>Neurological</th>
<th>Peripheral vascular</th>
<th>Cardiovascular</th>
<th>Renal</th>
<th>Ophthalmic</th>
<th>General medical conditions</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital inpatient</td>
<td>1,535</td>
<td>3,115</td>
<td>2,719</td>
<td>20,790</td>
<td>3,285</td>
<td>36</td>
<td>23,473</td>
<td>58,344</td>
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<tr>
<td>Physician’s office</td>
<td>2,899</td>
<td>382</td>
<td>382 279</td>
<td>1,004</td>
<td>323</td>
<td>899</td>
<td>3,830</td>
<td>9,897</td>
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<tr>
<td>Emergency department</td>
<td>234</td>
<td>138</td>
<td>43</td>
<td>403</td>
<td>132</td>
<td>11</td>
<td>2,717</td>
<td>3,870</td>
</tr>
<tr>
<td>Hospital outpatient</td>
<td>842</td>
<td>75</td>
<td>135</td>
<td>317</td>
<td>87</td>
<td>130</td>
<td>1,321</td>
<td>2,985</td>
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