Burden of Hospitalizations Primarily Due to Uncontrolled Diabetes: Implications of Inadequate Primary Health Care in the United States

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Running title: Burden of Preventable Hospitalizations
This study describes the burden of potentially preventable hospitalizations primarily due to uncontrolled diabetes. Uncontrolled diabetes, if not managed properly, often leads to biochemical imbalances that can cause acute life threatening events and hospitalizations. Since diabetes management relies heavily on ambulatory care, hospitalizations with uncontrolled diabetes largely reflects the quality of the primary health care provided outside the hospital setting. Therefore, the Agency for Healthcare Research and Quality (AHRQ) selected uncontrolled diabetes as a prevention quality indicator (PQI) where timely and appropriate ambulatory care would have prevented a hospitalization (1). To improve primary health care, it is essential to track an outcome of current status of prevention quality indicators. However, the extent of potentially preventable hospitalizations associated with uncontrolled diabetes and its economic burden in the U.S. remains under-investigated.

RESEARCH DESIGN AND METHODS

A primary diagnosis indicative of uncontrolled diabetes was analyzed using two nationally representative samples of inpatients records. First, to estimate the number of potentially preventable hospitalizations, the National Hospital Discharge Survey (NHDS) was analyzed. The NHDS-2004, the latest annual survey available (2), acquired a probabilistic sample of 370,785 inpatient records from a national sample of about 500 hospitals. Overall, the hospital response rate was 92% in 2004 (3). Details concerning sampling procedures are published elsewhere (4). Briefly, the NHDS, conducted annually since 1965, is the principal source for national data concerning characteristics of patients discharged from non-Federal, short-stay hospitals. This annual survey is conducted under the auspices of the National Center for Health Statistics, Centers for Disease Control and Prevention.

Second, the Healthcare Cost and Utilization Project –National Inpatient Survey” (HCUP-NIS), collected by the AHRQ, was analyzed to cross-validate the frequency of hospitalizations for uncontrolled diabetes that were estimated from the NHDS. Unlike the NHDS, the foundation of the HCUP is billing data which can yield estimates of national hospital charges as well as the total number of hospitalizations. In 2004, the HCUP-NIS database contained nearly 8 million records from about 1,000 hospitals (5). HCUPnet, a web-based interactive analytic tool, was used to generate statistics from HCUP-NIS (6).

Two PQIs associated with uncontrolled diabetes were “uncontrolled diabetes without complications” and “short-term complications (ketoacidosis, hyperosmolarity, and diabetic coma)”(7). Specifically, the designated uncontrolled diabetes conditions used were uncontrolled diabetes without complications [ICD-9-CM: 250.02, 250.03], ketoacidosis [ICD-9-CM: 250.10-250.13], hyperosmolarity [ICD-9-CM: 250.20-250.23], and diabetes associated coma [ICD-9-CM 250.3].

RESULTS

Based on the NHDS data, the total number of hospitalizations was calculated to be nearly 38.8 million (95% confidence interval [CI], 36.0-41.5 millions) in the U.S. during 2004. Approximately 5.2 million admissions had at least one diagnostic coding indicative of diabetes; and nearly 609,000 admissions were primarily as a result of diabetes. Among these 609,000 admissions, nearly 191,181 (or 32%) were due to uncontrolled diabetes conditions. Among the 191,181 inpatient files with a primary diagnosis indicative of uncontrolled diabetes, half of hospital visits were made by males; 50.9% of hospitalizations were made by whites, 21.4% by blacks, and the remaining 27.7% were by all other races; 39% were made by individuals...
younger than 35 years old and 19% were made by individuals older than 65 years old. Nearly 94.1% of admissions were either an emergency or urgent type admission; Medicare and Medicaid were the principal sources of payment for 49% of these hospitalizations. Based on the DRG codes in the inpatient records, the total estimated hospital reimbursement was nearly 2.4 billion dollars.

Next, to enhance the validity of estimates, the number of hospitalizations with a primary diagnosis indicative of uncontrolled diabetes was compared to that of the HCUP-NIS data. During the same time period, the estimated number of total hospitalizations was 196,324 which was within the 95% confidence interval estimated from the NHDS. Specific diagnoses of uncontrolled diabetes hospitalizations, shown in Table 1, were remarkably close to each other; uncontrolled diabetes without complications [52,798 vs. 52,294], ketoacidosis [119,174 vs. 124,510], hyperosmolarity [14,984 vs. 14,572], and diabetic coma [4,225 vs. 4,948]. According to the HCUP-NIS billing data, the total estimated hospital charges associated were nearly 2.8 billion dollars (Table 1).

CONCLUSIONS
The study’s results provide valuable insights on the primary care of diabetes. Most of potentially preventable hospitalizations are not occurring among the aged. Children and younger adults account for almost 40% of the events. The prevalence of potentially preventable hospitalizations among blacks was more than double compared to that of whites. This study estimated 97,322 hospitalizations for whites and 40,982 hospitalizations for black. The number of people with diagnosed diabetes for whites and blacks were 11,659,000 and 2,322,000, respectively (8). Therefore, per 1,000 people with diagnosed diabetes, whites had 8 preventable hospitalizations and blacks had 18 preventable hospitalizations during 2004.

Although the estimation is not available in this national database, some part of preventable hospitalizations may be due to a failure of our healthcare system by which we admit people to the hospital for conditions that could be managed with short observation stays in the emergency room (ER). Due to the lack of a short stay unit in the ER, some patients who need a couple hours of intravenous fluids and insulin may be admitted to the hospital. Another data limitation is the inability to estimate the extent of uncontrolled diabetes hospitalizations triggered by co-morbid conditions. Further study is needed to address these issues.

This study’s results showed that the cost burden resulting from avoidable hospitalizations due to short-term uncontrolled diabetes is substantial (2.8 billion dollars). However, the long-term impact of uncontrolled diabetes and its economic burden could be more significant. Over time, uncontrolled diabetes can contribute to various complications. Given the steeply and ever-increasing prevalence of diabetes, the avoidable burden associated with preventable diabetes hospitalizations will increase if this problem is not addressed immediately. Although other factors such as a lack of patient adherence to treatment can also result in hospitalizations, admissions made with uncontrolled diabetes are good indicators for assessing the quality of timely and appropriate ambulatory care in the community (9,10). Improved accessibility to primary health care and patient education would save substantial social costs.
Reference List


Table 1. Hospitalizations resulting from the preventable hospitalizations in U.S. Total number of admissions were cross-validated between two independently collected national databases.

<table>
<thead>
<tr>
<th>Uncontrolled Diabetes diagnosis [ICD-9-CM code]</th>
<th>(I) Hospitalizations estimated from the NHDS-2004*</th>
<th>Total admissions [95% CI]</th>
<th>Total hospital Reimbursement</th>
<th>(II) Hospitalizations estimated from the HCUP-NIS†</th>
<th>Total admissions</th>
<th>Total Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>without complications [250.02, 250.03]</td>
<td>52798 [43976, 61620]</td>
<td>$722 million</td>
<td>52294</td>
<td>$552 million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with ketoacidosis [250.10-250.13]</td>
<td>119174 [104485,133863]</td>
<td>$1372 million</td>
<td>124510</td>
<td>$1821 million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with hyperosmolarity [250.20-250.23]</td>
<td>14984 [10601, 19367]</td>
<td>$201 million</td>
<td>14572</td>
<td>$298 million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with diabetic coma [250.30-250.33]</td>
<td>4225 [1948, 6502]</td>
<td>$84 million</td>
<td>4948</td>
<td>$164 million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>191181 [170786, 211576]</td>
<td>$2380 million</td>
<td>196324</td>
<td>$2836 million</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*National Hospital Discharge Survey-2004, Center for Disease Control & Prevention
†Healthcare Cost and Utilization Project –National Inpatient Survey, Agency for Health Research and Quality