

# Burden of Hospitalizations Primarily Due to Uncontrolled Diabetes

## Implications of inadequate primary health care in the United States

SUNNY KIM, PHD

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 reflect 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 ~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 nonfederal, 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 Health Care Cost and Utilization Project (HCUP) National Inpatient Survey (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 ~8 million records from about 1,000 hospitals (5). HCUP net, 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 ~38.8 million (95% CI 36.0–41.5 million) in the U.S. during 2004. Approximately 5.2 million admissions had at least one diagnostic coding indicative of diabetes, and ~609,000 admissions were primarily a result of diabetes. Among these 609,000 admissions, ~191,181 (or 32%) were due to uncontrolled diabetes conditions. Among the 191,181 inpatient files with a primary diagnosis indicative of uncontrolled diabetes, one-half of hospital visits were made by males, and 50.9% of hospitalizations were made by whites, 21.4% by blacks, and the remaining 27.7% were by all other races. Individuals aged <25 years constituted 39% of hospitalizations, and 19% were made by individuals >65 years old. Nearly 94.1% of admissions were either emergencies or urgent, and Medicare and Medicaid were the principal sources of payment for 49% of these hospitalizations. Based on the Diagnostic Related Group codes in the inpatient records, the total estimated hospital reimbursement was ~2.4 billion dollars.

To enhance the validity of estimates, the number of hospitalizations with a primary diagnosis indicative of uncontrolled diabetes was compared with 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% CI estimated from the NHDS. Specific diagnoses of uncontrolled diabetes hospitalizations, as 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

From the Department of Epidemiology and Biostatistics, Stempel School of Public Health, Florida International University, Miami, Florida.

Address correspondence and reprint requests to Sunny Kim, School of Public Health, HLS 575, Florida International University, 11200 SW 8th St., Miami, FL 33199. E-mail: skim@fiu.edu.

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**Abbreviations:** AHRQ, Agency for Healthcare Research and Quality; HCUP, Healthcare Cost and Utilization Project; NIS, National Inpatient Survey; PQI, prevention quality indicator.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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Table 1—Hospitalizations resulting from the preventable hospitalizations in U.S.

Uncontrolled diabetes diagnosis (ICD-9-CM code)	Hospitalizations estimated from the NHDS-2004		Hospitalizations estimated from the HCUP-NIS	
	Total admissions (95% CI)	Total hospital reimbursement (\$)	Total admissions (n)	Total charge (\$)
Without complications (250.02–250.03)	52,798 (43,976–61,620)	722 million	52,294	552 million
With ketoacidosis (250.10–250.13)	119,174 (104,485–133,863)	1,372 million	124,510	1,821 million
With hyperosmolarity (250.20–250.23)	14,984 (10,601–19,367)	201 million	14,572	298 million
With diabetic coma (250.30–250.33)	4,225 (1,948–6,502)	84 million	4,948	164 million
Total	191,181 (170,786–211,576)	2,380 million	196,324	2,836 million

Total number of admissions were cross-validated between two independently collected national databases.

with these hospitalizations were ~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 elderly. Children and younger adults account for ~40% of the events. The prevalence of potentially preventable hospitalizations among blacks was more than double compared with that of whites. This study estimated 97,322 hospitalizations for whites and 40,982 hospitalizations for black. The number of individuals with diagnosed diabetes for whites and blacks was 11,659,000 and 2,322,000, respectively (8). Therefore, per 1,000 individuals 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 preventable hospitalizations may be due to a failure of our health care system in which we admit people to the hospital for conditions that could be managed with short observation stays in the emergency room. Due to the lack of short stays in the emergency room, 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 comorbid 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 steep 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.

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