

Excessive Hospitalizations and Its Associated Economic Burden among People with Diabetes in the United States

Sunny Kim, PhD,¹ Kristina S. Boye, PhD²

¹Florida International University, Miami, FL, USA; ²Global Health Outcomes, Eli Lilly and Company, Indianapolis, IN, USA

ABSTRACT

Objectives: We conducted this study to estimate the excessive hospital admission among people with diabetes and the associated economic burden in the USA.

Methods: The study was based on the 2005 Nationwide Inpatient Sample (NIS), a nationally representative probability sample conducted annually by the Agency of Health Research and Quality. Nearly 8 million records were sampled from over 1000 community hospitals in the 2005 NIS.

Results: Excluding childbirth-related admissions, the estimated US hospitalizations numbered approximately 30.8 million; individuals with diabetes accounted for over 6.4 million (20.9%) of these admissions. For every 1000 individuals without diabetes, with type 1 diabetes, and with type 2 diabetes, the numbers of hospitalizations were 89, 418, and 303, respectively. The rates of hospitalization increased greatly by the presence of

diabetes for all age groups and sex. During 2005, the national bill of hospital charges and costs for individuals with diabetes exceeded US\$171 billion and US\$90 billion, respectively. If the prevalence of diabetes increases to 7.5% from 7.0%, the total number of hospitalizations made by individuals with diabetes will be 7.5 million in 2015.

Conclusions: Although approximately 7% of the population had diabetes in the USA, nearly 20.9% of hospitalizations were made by individuals with this condition. Due to the excessive hospitalizations incurred by patients with diabetes, a small increase in the number of people with diabetes will amplify the number of hospitalizations. Health-care communities should anticipate this possible increased demand of hospitalizations and the associated economic burden.

Keywords: diabetes, health-care costs, health-care utilization, USA.

Introduction

Diabetes is rapidly on the rise. Diagnosed diabetes is projected to increase by 165%, from 11 million in 2000 to 29 million by 2050 in the USA [1]. In the year 2005, over 14.6 million Americans had diagnosed diabetes and another 6.2 million Americans were not aware that they had the disease [1]. The Centers for Disease Control and Prevention recently referred to diabetes as the “epidemic of our time”; therefore understanding and preparing for the upcoming demand of medical care for people with diabetes is significant. Nevertheless, although it is known that individuals with diabetes have higher rates of hospitalization than the general population [2–4] and that care of their care requires longer lengths of hospitalization for any given admission diagnosis [5,6], there is little information about the extent of hospitalizations by individuals with diabetes and its economic burden in the USA.

The purpose of this study, therefore, is to describe the excessive hospital admissions among people with diabetes compared with people without diabetes in the USA. Further, this study describes the economic burden of hospitalizations made by individuals with diabetes. Because the number of people with diabetes is likely to continue to increase [7], this added knowledge will further inform health-care systems in anticipating this upcoming demand for hospitalizations and the associated economic burden.

Methods

The Nationwide Inpatient Sample (NIS), a nationally representative sample of inpatient records, was analyzed to evaluate the excess hospitalizations among people with diabetes in the USA.

Address correspondence to: Sunny Kim, School of Public Health, HLS 575, Florida International University, 11200 S.W. 8th Street, Miami, FL 33199, USA. E-mail: skim@fiu.edu
10.1111/j.1524-4733.2008.00443.x

This study was reviewed by the Institutional Review Board (IRB) and classified as ‘exempt’ for IRB purposes.

NIS Sampling Design and Data Availability

The NIS-2005, a part of the Healthcare Cost and Utilization Project (HCUP), is a database of hospital inpatient stays. The NIS is the only all-payer inpatient care database in the USA [8]. This annual cross-sectional survey is conducted under the auspices of the Agency of Health Research and Quality (AHRQ), and the database is available to researchers on completion of the HCUP data use agreement course. The NIS is the principal source for national data concerning characteristics of patients discharged from non-Federal, short-stay community hospitals. The NIS data include obstetrics and gynecology (OB-GYN), Ear Nose Throat (ENT), orthopedic, cancer, pediatric, public, and academic medical hospital data regardless of payer including persons covered by Medicare, Medicaid, private insurance, and the uninsured. Although the NIS excludes long-term care, rehabilitation, psychiatric, and alcoholism and chemical dependency hospitals, these type of admissions are included if they are from community hospitals.

Details concerning sampling procedures are published elsewhere [9]. Briefly, the primary objective of the NIS data selection was to obtain a “representative sample of inpatient records in the US” for surveillance. The NIS selected probability samples of 20% of the US community hospitals to produce a nationally representative sample. All inpatient records in the sampled hospitals were then included. In the year 2005 alone, the NIS contained a probabilistic sample of approximately 8 million (n = 7,995,048) records from over 1000 hospitals.

Exclusion Criteria

The main purpose of our study was to estimate excessive hospitalizations incurred by patients with type 1 or type 2 diabetes (but not gestational diabetes) as their comorbid condition. To

avoid overestimating the hospitalization morbid rate among Americans with diabetes, admissions that resulted from normal childbirth and newborn babies were excluded. Even if a woman was hospitalized with type 1 or type 2 diabetes, if the admission resulted from normal childbirth, hospitalization may not be avoided whether diabetes was a comorbid condition or not. The Clinical Classification Software (CCS), developed by AHRQ, is a diagnosis and procedure categorization scheme which is based on the International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM). Based on all 15 diagnosis fields, the AHRQ provided CCS codes corresponding to childbirth and newborn babies, which were used to exclude these hospitalizations from analysis.

Identification of Type 1 and Type 2 Diabetes

All primary and secondary diagnosis fields in the inpatient record were evaluated to identify the type of diabetes. The type 1 diabetes condition is identified by ICD-9-CM code 250.X1 or 250.X3 and the type 2 diabetes condition is identified by ICD-9-CM code 250.X0 or 250.X2, where X = 0 to 9. If at least one out of 15 diagnosis fields indicated one type of diabetes, then the inpatient records were selected and named with "hospitalizations with type 1" or "hospitalizations with type 2." The remainder of this article reflects all hospitalizations incurred by individuals with diabetes and does not infer that the hospitalizations are due to diabetes. Further, to identify the most common reason of hospitalizations for each type of diabetes group, the primary ICD-9-CM code was studied. The primary diagnosis in the patient record is the condition chiefly responsible for the patient's admission to the hospital.

Estimation of Hospital Charges and Costs

The financial burden of hospitalizations was estimated using hospital charges and hospital costs. Hospital charges refer to the amount the hospital billed only, and do not include professional (physician) fees. The hospital costs were then estimated multiplying the average cost-to-charge ratios found from the cost-to-charge ratio file provided by the AHRQ. The AHRQ's cost-to-charge ratio file is constructed using all-payer, inpatient cost, and charge information from the detailed reports by hospitals to the Center for Medicare and Medicaid Services.

Rates of Hospitalization

Annual rates of hospitalization for individuals with and without diabetes were calculated by dividing the number of hospitalizations by the respective population size. For instance, the annual rate for those with type 2 diabetes is the number of hospitalizations with type 2 diabetes divided by the number of people with type 2 diabetes in the US population. The numerators (the total number of hospitalizations made by individuals with or without diabetes during 2005) were estimated from the NIS data. The denominator (the number of people with or without diabetes in the USA during the year 2005) was obtained from the National Diabetes Information Clearinghouse (NDIC), National Institute of Diabetes and Digestive and Kidney Diseases [1]. According to the NDIC, in 2005, the prevalence of diabetes in the US population was 7% (20.8 million). Among 20.8 million Americans with diabetes, approximately 14.6 million people were diagnosed and the remaining 6.2 million people were not diagnosed. Because the numerator included all hospitalizations with diabetes at the time of hospitalizations regardless of the patient's previous diagnosis, the corresponding denominator also included all Americans with undiagnosed/diagnosed diabetes to avoid over-

estimating the rates of hospitalization among people with diabetes. This report also stated that approximately 5% to 10% of diagnosed diabetes was type 1. In our study, we assumed that 7% of diagnosed diabetes in the USA was type 1 diabetes.

Relative Risk of Hospitalizations among Individuals with Diabetes

The relative risk of hospitalization was then calculated by dividing the rate of hospitalization of individuals with each type of diabetes by the rate of hospitalization of individuals without diabetes. To estimate the differential impact of diabetes on hospitalizations, a relative risk was calculated for different age groups among adults. Specifically, for each age group, the rate of hospitalizations among Americans with diabetes was divided by the rate of hospitalizations among Americans without diabetes. Finally, the magnitude of excessive hospitalizations among people with diabetes was calculated by the difference in the hospitalization rate between groups of individuals with type 1 or type 2 diabetes compared with individuals without diabetes.

Statistical Analysis

Because the NIS is a probabilistic sample survey, the sampling weight and sampling design were considered in calculating total hospitalizations and their standard errors. Sampling weights were used to account for unequal sampling probabilities and to produce estimates for all hospital discharges in the USA. The population estimation was weighted considering: 1) probability of selection; and 2) the nonresponse rate of the hospital. Because the main purpose of the survey study is estimation, whenever possible, the 95% confidence interval (CI) was reported along with the point estimation. Standard error was estimated by Taylor's linearization [10]. All analyses of the NIS-2005 were performed using the statistical package, STATA version 10.0 [11].

Results

Based on the sampling weight and probabilistic sampling design, the total number of hospitalizations was calculated to be nearly 39.2 million (95% CI 37.7–40.7 million) in the USA during 2005. After excluding normal pregnancy or newborn babies, the estimated number of hospitalizations was approximately 30.8 million (95% CI 29.6–31.9 million) in the USA and only these hospitalizations were included in the subsequent data analysis. Given that the US population size was 295.5 million during the same time period [12], 30.8 million hospitalizations mean that there were approximately 100 hospitalizations for every 1000 individuals in the USA.

Excessive Hospitalizations among All Americans with Diabetes

Approximately 20.9% (or 6.42 million) of total 30.8 million hospitalizations were made by people with diabetes. Specifically 5,986,000 (95% CI 5,840,000–6,132,000) hospitalizations were made by patients with type 2 diabetes and another 435,000 (95% CI 417,000–453,000) hospitalizations were made by patients with type 1 diabetes (Table 1). Because we found that 5,986,000 hospitalizations were made by 19,760,000 Americans with type 2 diabetes, the annual rate of hospitalizations in this group was approximately 303 per 1000 individuals ($5,986,000/19,760,000 = 0.3029$). Table 1 summarized that, for every 1000 people, the number of hospitalizations was 89,418, and 303 among people without diabetes, with type 1 diabetes, and with type 2 diabetes, respectively. Therefore, people with type 1 and

type 2 diabetes had 4.7 and 3.4 times more episodes of hospitalization, respectively, compared with people without diabetes. The number of hospitalizations was 309 per every 1000 Americans with diabetes (not shown in Table 1) when considering both types of diabetes. When the same rate of hospitalizations for Americans without diabetes was applied to the Americans with diabetes, approximately 1.84 million hospital admissions were expected. Therefore, 4.58 million (= 6.42 million – 1.84 million) more hospitalizations incurred by Americans with diabetes.

Hospital Charges and Costs Made by All Inpatients with and without Diabetes

In 2005, median hospital charges were US\$14,300 for those without diabetes, US\$13,700 for patients with type 1 diabetes, and US\$ 16,200 for patients with type 2 diabetes (Table 1). The “national bill,” the sum of all charges for all hospital stays in US community hospitals, was over 795 billion US dollars (Table 1). The national bill of hospital charges for people with type 1 and type 2 diabetes as their primary or secondary admission diagnosis was over 171 billion dollars. Although only 7% of the population has either diagnosed or undiagnosed diabetes, nearly 22% of hospital charges were made by individuals with the condition. During the same time period, the average cost-to-charge ratio was calculated to be 0.523 in the nation. That is, approximately 52.3% of hospital charges were actual hospital costs incurred. Therefore, the national bill of hospital costs for patients with diabetes was nearly US\$90 billion dollars. Hospital costs do not include professional fees, and the actual costs may be substantially higher.

Primary Diagnosis among All Inpatients with and without Diabetes

Among people without diabetes, pneumonia was the most common reason for hospitalizations, which accounts for 4.4% of all hospitalizations followed by coronary atherosclerosis and other heart disease (3.1%) and congestive heart failure (2.7%) (Table 2). Among people with type 1 diabetes, the most common reason for hospitalization was the complication of diabetes (CCS = 50), which accounts for one-third (32.8%) of all hospitalizations with type 1 diabetes. The AHRQ's CCS = 50 consists of all ICD-9-CM codes of 250 except 25000 and 25001. Among people with type 2 diabetes, the most common reason for hospitalization was heart disease. Nonhypertensive congestive heart failure and coronary atherosclerosis accounted for 7% and 5.9% of all hospitalizations with type 2 diabetes. The third most common reason for hospitalizations was for diabetes complications which accounts for 5.8% of all hospitalizations with type 2 diabetes (Table 2).

Anticipated Hospitalizations by All Americans with Diabetes in the Near Future

The number of people with diabetes was projected using the possible range of diabetes prevalence as well as the growth of the US population obtained from the US Census [13]. In 2005, the prevalence of diabetes in the US population was 7%. Given that the US population is getting older and has a high prevalence of obesity, the prevalence of diabetes is also likely to continue to increase. Therefore, we calculated the number of people with diabetes for the diabetes prevalence ranging from 7.0% to 8.5% (Fig. 1). In the previous section, the reported number of hospitalizations among people with diabetes was 309 per 1000 individuals. In projecting the number of future hospitalizations, we assumed the same rate of hospitalizations to the projected population size in the USA [13]. As shown in Figure 1, if the prevalence of diabetes remains 7% for the next 10 years, the total number of hospitalizations made by individuals with diabetes will be 6.7 million in 2010 and 7.0 million in 2015. Nevertheless, if the prevalence of diabetes increases to 8.5%, then we anticipate 8.5 million hospitalizations by individuals with diabetes in 2015.

Excessive Hospitalizations among “Adults” with Diabetes by Age and Sex

The NDIC reported the prevalence of diabetes by age and sex only for adults aged 20 years and older (hereafter referred to as “adults”). Table 3 presents the rate of hospitalizations for adults with and without diabetes which were calculated based on the NDIC report. In 2005, among 214.6 million adult Americans [12], nearly 20.6 millions (9.6%) had diabetes [1]. With nearly 6.36 million hospitalizations in this population of patients with diabetes, approximately 307 hospitalizations were therefore made for every 1000 adults with diabetes. Conversely, the rate of hospitalizations among adults without diabetes was only 110 for every 1000 people without diabetes. Consequently, for every 1000 adults in the US population, nearly 197 more hospitalizations were made by adults with diabetes compared with adults without diabetes.

The rates of hospitalization increased greatly by the presence of diabetes for all age groups and sex (Table 3). For example, among people aged 20 to 39 years, there were 46 hospitalizations out of 1000 people without diabetes compared with 177 hospitalizations out of 1000 people with diabetes. The relative risk of hospitalization for individuals with diabetes was 3.9 times higher than individuals without diabetes in this age group. The relative risk of hospitalizations among adults with diabetes compared with adults without diabetes was inversely related to age; 2.5 times among those aged 40 to 59 years old and 1.4 times among those aged 60 years or older. Among the elderly aged 60 years or

Table 1 Excess hospitalizations among people with diabetes in the USA during the year 2005

	Size of US population (in 1,000)*	Total hospitalizations (in 1,000) [†]	Hospitalizations per 1,000 people (95% CI) [‡]	Median hospital charge (US\$)	Total national bill of charges (US\$ in million)
No DM	274,707	24,343	89 (88,89)	14,300	624,150
Type 1 DM	1,040	435	418 (401,435)	13,700	11,374
Type 2 DM	19,760	5,986	303 (296,310)	16,200	159,642
Total	295,507	30,764	104	14,639	795,167

*US population in July 1, 2005. Prevalence of diabetes in the USA is from NIDDK, NIH (<http://diabetes.niddk.nih.gov/dm/pubs/statistics/index.htm#7>).

[†]Total hospitalizations were calculated from the HCUP-NIS, 2005.

[‡]Hospitalizations per 1000 people are calculated from the total hospitalizations/total number of people with/without conditions.

DM, diabetes mellitus; HCUP, Healthcare Cost and Utilization Project; NIDDK, National Institute of Diabetes and Digestive and Kidney Diseases; NIH, National Institutes of Health; NIS, Nationwide Inpatient Sample.

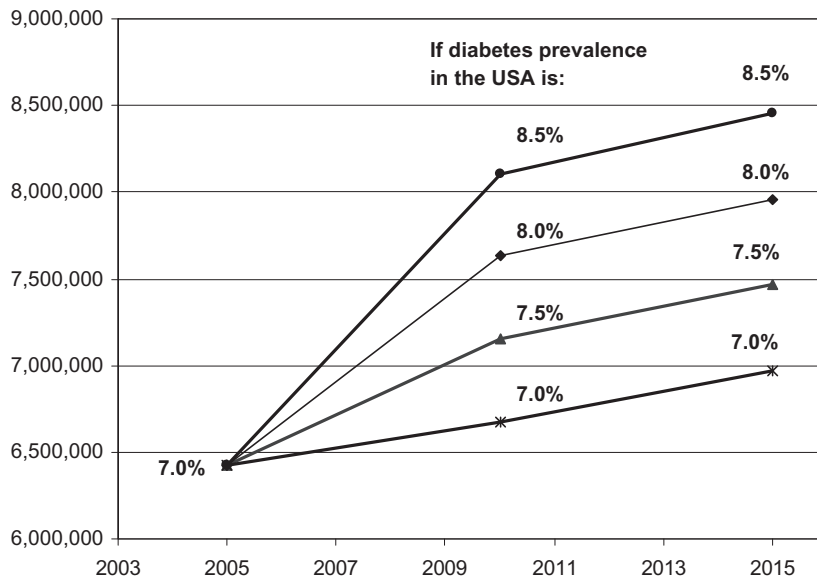


Figure 1 Anticipated number of hospitalizations by individuals with diabetes for selected diabetes prevalence in the USA. In 2005, the prevalence of diabetes in the US population was 7%. The number of people with diabetes was calculated for selected diabetes prevalence and the growth of US population obtained from the US Census.

older, hospitalizations were frequent regardless of the presence/absence of diabetes. Moreover, individuals with diabetes accounted for a disproportionate share of hospitalizations for both adult males and females. For every 1000 adult males in the respective population, the numbers of hospitalizations were 101 and 271 for those without and with diabetes, respectively. The same pattern was observed among adult females (119 vs. 349 for every 1000 adult females with respective population).

Payers for Hospitalizations of Patients with and without Diabetes

Medicare was billed for 49.2% of hospitalizations without diabetes and 63.9% of hospitalizations with diabetes. In terms of the amount of hospital charges, nearly 109 billion dollars was billed to Medicare by patients with diabetes. Private insurance was billed for 31% of hospitalizations without diabetes and 21% of hospitalizations with diabetes. People with diabetes were slightly more likely to be admitted through the emergency

department (53% of hospitalizations without diabetes and 58% of hospitalizations with diabetes).

Discussion

This study found that for every 1000 Americans, the numbers of hospitalizations were 89 and 309 among people without and with diabetes, respectively. A study in Spain reported 70 and 145 hospitalizations among inhabitants without and with diabetes [3]. Although Americans without diabetes were also more likely to be hospitalized (89 vs. 70 for every 1000 respective population), Americans with diabetes were two times more likely to be admitted to hospitals compared to that of Spain (309 vs. 145 for every 1000 respective population). The study in Spain is based on hospitals in one jurisdiction and may not accurately represent the entire nation. Further study is needed to address whether individuals with diabetes in the USA are truly more likely to be hospitalized. Regardless, this excess hospitalization in the USA provides valuable implications on the demand for inpatient care. The number of people with diabetes is likely to continue to

Table 2 Ten most common primary diagnoses by presence/type of diabetes in the USA during the year 2005

Among without diabetes			Among type 1 diabetes		Among type 2 diabetes	
Primary diagnosis	%*		Primary diagnosis	%	Primary diagnosis	%
1	Pneumonia	4.4	Diabetes mellitus with complications	32.8	Congestive heart failure; nonhypertensive	7.0
2	Coronary atherosclerosis and other heart disease	3.1	Congestive heart failure; nonhypertensive	3.9	Coronary atherosclerosis and other heart disease	5.9
3	Congestive heart failure; nonhypertensive	2.7	Coronary atherosclerosis and other heart disease	3.0	Diabetes mellitus with complications	5.8
4	Nonspecific chest pain	2.6	Complication of device; implant or graft	2.9	Pneumonia	4.6
5	Osteoarthritis	2.5	Pneumonia	2.8	Nonspecific chest pain	3.3
6	Affective disorders	2.4	Skin and subcutaneous tissue infections	2.6	Acute myocardial infarction	3.2
7	Cardiac dysrhythmias	2.3	Diabetes mellitus without complications	2.4	Chronic obstructive pulmonary disease and bronchiectasis	2.5
8	Spondylosis; other back problems	2.0	Septicemia (except in labor)	2.1	Complication of device; implant or graft	2.4
9	Chronic obstructive pulmonary disease and bronchiectasis	1.9	Acute myocardial infarction	1.9	Acute cerebrovascular disease	2.4
10	Acute myocardial infarction	1.9	Fluid and electrolyte disorders	1.8	Skin and subcutaneous tissue infections	2.4

*Percent of discharges among inpatients without diabetes, with type 1 diabetes, or with type 2 diabetes. Because 10 most common primary diagnosis was listed in the table, the percentage does not add up to 100%.

Table 3 Excessive hospitalizations incurred by patients with diabetes among people aged 20 years or older, United States, 2005

	US population July 2005 (in 1,000)*	Without diabetes in USA			With diabetes in USA		
		Number of people without diabetes (in 1,000) [†]	Hospital admission (in 1,000) [‡]	Per 1,000 people [§]	Number of people with diabetes (in 1,000) [†]	Hospital admission (in 1,000) [‡]	Per 1,000 people [§]
Age (years)							
20–39	82,183	80,210	3,669	46	1,969	350	177
40–59	82,696	74,344	6,390	86	8,197	1,776	213
60+	49,722	39,330	11,355	289	10,300	4,230	407
Sex							
Males	104,195	93,255	9,373	101	10,900	2,960	271
Females	110,473	100,752	11,991	119	9,700	3,396	349
Total size	214,601	194,885	21,298	110	20,600	6,357	307

*US population in year 2005 http://www.census.gov/popest/archives/2000s/vintage_2005/.

[†]Number of people with diabetes in the USA is from NIDDK, NIH (<http://diabetes.niddk.nih.gov/dm/pubs/statistics/index.htm#7>).

[‡]Total hospitalizations were calculated from the HCUP-NIS, 2005.

[§]Hospitalizations per 1000 people are calculated from the total hospitalizations divided by the number of hospitalizations by the respective population.

HCUP, Healthcare Cost and Utilization Project; NIDDK, National Institute of Diabetes and Digestive and Kidney Diseases; NIH, National Institutes of Health; NIS, Nationwide Inpatient Sample.

increase [7]. Because the individuals with type 1 and type 2 diabetes were 4.7 and 3.4 times more likely to be hospitalized, a small increase in the prevalence of diabetes will amplify the number of hospitalizations by 3 to 4 times.

Although type 1 diabetes is relatively uncommon compared to type 2 diabetes in the general population, given the size of the type 1 population, these individuals were more likely to be hospitalized. This was an unexpected finding because type 2 diabetes is more common among the older population. Diabetes complications were the most common reason for hospitalization accounting for 32.8% of hospitalizations with type 1 diabetes. Complications of diabetes were the primary reason for 5.8% of hospitalizations with type 2 diabetes. This suggests that management of hyperglycemia may be an important factor to reduce hospitalizations among individuals with diabetes. Studies have reported that the glycemic control was a strong predictor of hospitalizations for diabetes [14,15]. In 2004 in the USA, nearly 200,000 hospitalizations were primarily due to short-term diabetes complications such as ketoacidosis, hyperosmolarity, and diabetic coma [16]. Ambulatory care visits to at-risk patients with diabetes significantly reduced hospital use [17]. Because diabetes management relies heavily on ambulatory care, improved accessibility to primary health care and patient education particularly targeted toward children and younger adults would reduce the hospitalizations due to short-term diabetes complications as well as long-term diabetes complications in the future.

The relative impact of diabetes on hospitalizations is greater among younger adults compared with the elderly. Among the elderly aged 60 years or older, hospitalizations were frequent regardless of the presence/absence of diabetes. Although majority of all hospitalizations occur in the age 60 years and older group, the disparity between diabetes and nondiabetes is smallest. Hospitalization was 1.4 times more likely among the elderly with diabetes compared to the elderly without diabetes. Nevertheless, among younger adults aged 20 to 49 years old, hospitalization was noticeably more common (relative risk = 3.6 times) among individuals with diabetes compared with individuals without diabetes. The number of young adults hospitalized with diabetes in the USA increased significantly over the last decade [18]. Most of hospitalizations with short-term diabetes complications were occurring among children and younger adults [16]. Due to the frequent hospitalizations compared to their age cohort without diabetes, living with diabetes could cause greater emotional stress among younger adults. Further study is needed to investigate the relative emotional impact among younger adults with diabetes.

There are several limitations with this study. This study was based on the hospital records which included hospital charges

but not professional fees. Therefore, if the amount of professional fees could be considered, the disparity in hospitalization costs between individuals with diabetes and without diabetes could be increased. Each observation in the NIS is a hospital discharge record rather than a patient. The patient identifier was not available in the NIS data and some patients may have had more than one episode of hospitalization. Multiple hospitalizations are common among patients with diabetes [19]. Because all hospital admissions are subject to resource utilization, the inclusion of multiple hospitalizations is not a limitation to the main objective of the study. Nevertheless, we could not profile the characteristics of patients with diabetes who were repeatedly admitted. Additionally, our study considered patients with diagnosed and undiagnosed diabetes in the USA. Thus, the inclusion of approximately 6 million undiagnosed patients with diabetes may have underestimated the rate of hospitalization among patients with diabetes. Finally, it is assumed that the hospitals kept medical records correctly and coded appropriately. Although we assumed that physicians completed the diagnosis appropriately, it is not known how well medical records reflect accurate diagnoses.

Conclusion

This study showed excessive hospitalizations among people with diabetes compared with people without diabetes for all age groups. Although approximately 7% of the population had either diagnosed or undiagnosed diabetes in the USA, nearly 20.9% of hospitalizations were made by people with diabetes. The size of the US population is known to be growing because of more births than deaths as well as high immigration rates. The baby boomer generation is getting older and more Americans are becoming overweight/obese; hence the prevalence of diabetes is also likely to continue to increase and we can anticipate an increasing demand for hospitalizations. Public health education is undoubtedly important to reduce diabetes prevalence as well as to achieve and maintain diabetes control. At the same time, health-care communities should anticipate this probable increase in demand for hospital care and increasing financial burdens.

References

- 1 Department of Health and Human Services. Centers for Disease Control and Prevention: national diabetes fact sheet: general information and national estimates on diabetes in the United

- States, 2005. Available from: http://www.cdc.gov/Diabetes/pubs/pdf/ndfs_2005.pdf [Accessed January 20, 2008].
- 2 Bo S, Ciccone G, Grassi G, et al. Patients with type 2 diabetes had higher rates of hospitalization than the general population. *J Clin Epidemiol* 2004;57:1196–201.
 - 3 Oliveira-Fuster G, Olivera-Marquez P, Carral-Sanlaureano F, et al. Excess hospitalizations, hospital days, and inpatient costs among people with diabetes in Andalusia, Spain. *Diabetes Care* 2004;27:1904–9.
 - 4 Russell L, Valiyeva E, Roman S, et al. Hospitalizations, nursing home admissions, and deaths attributable to diabetes. *Diabetes Care* 2005;28:1611–7.
 - 5 Donnan P, Leese G, Morris AD. Hospitalizations for people with type 1 and type 2 diabetes compared with the nondiabetic population of Tayside, Scotland: a retrospective cohort study of resource use. *Diabetes Care* 2000;23:1774–9.
 - 6 Williams L, Rotich J, Qi R. Effects of admission hyperglycemia on mortality and costs in acute ischemic stroke. *Neurology* 2002;59:67–71.
 - 7 Harris M, Flegal K, Cowie C, et al. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in US adults. The third national health and nutrition examination survey, 1988–94. *Diabetes Care* 1998;21:518–24.
 - 8 Agency for Healthcare Research and Quality, Department of Health and Human Services. Fact sheet: databases and related tools from the healthcare cost and utilization project (HCUP) –update. Available from: <http://www.ahrq.gov/data/hcup/datahcup.htm> [Accessed January 20, 2008].
 - 9 Agency for Healthcare Research and Quality. Department of health and human services: changes in NIS sampling and weighting strategy for 1998. Available from: http://www.hcup-us.ahrq.gov/db/nation/nis/reports/Changes_in_NIS_Design_1998.pdf [Accessed January 20, 2008].
 - 10 Levy PS, Lemeshow S. *Sampling of Populations: Methods and Applications*. New York: John Wiley & Sons Inc, 1999.
 - 11 StataCorp. *Stata Statistical Software: Release 10*. College Station, TX: StataCorp LP, 2007.
 - 12 US Census Bureau, Population Division. US population in year 2005. Available from: http://www.census.gov/popest/archives/2000s/vintage_2005/ [Accessed November 12, 2007].
 - 13 US Census Bureau, Population Division. Interim Projections of the Total Population for the United States and States: April 1, 2000 to July 1, 2030, Available from: <http://www.census.gov/population/projections/SummaryTabA1.xls> [Accessed November 12, 2007].
 - 14 Moss SE, Klein R, Klein BE. Risk factors for hospitalization in people with Diabetes. *Arch Intern Med* 1999;159:2053–7.
 - 15 Palta M, LeCaire T, Daniels K, et al. Risk factors for hospitalization in a cohort with Type 1 Diabetes. Wisconsin diabetes registry. *Am J Epidemiol* 1997;146:627–36.
 - 16 Kim S. Burden of hospitalizations primarily due to uncontrolled diabetes: implications of inadequate access to primary health care in the United States. *Diabetes Care* 2007;30:1281–2.
 - 17 Laffel LM, Brackett J, Ho J, Anderson BJ. Changing the process of diabetes care improves metabolic outcomes and reduces hospitalizations. *Qual Manag Health Care* 1998;6:53–62.
 - 18 Lee J, Okumura M, Freed G, et al. Trend in hospitalizations for diabetes among children and young adults. *Diabetes Care* 2007;30:3035–9.
 - 19 Jiang HJ, Stryer D, Friedman B, Andrews R. Multiple hospitalizations for patients with diabetes. *Diabetes Care* 2003;26:1421–6.