

ORIGINAL ARTICLE

Diabetes Prevalence and Influence on Resource Use in Washington State Inpatient Rehabilitation Facilities, 2001 to 2007

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ABSTRACT. Weeks DL, Daratha KB, Towle LA. Diabetes prevalence and influence on resource use in Washington State inpatient rehabilitation facilities, 2001 to 2007. *Arch Phys Med Rehabil* 2009;90:1937-43.

Objective: To determine the prevalence of diabetes in inpatient rehabilitation facilities in Washington State from 2001 to 2007, and to determine the impact of diabetes on length of stay (LOS) and charges per day.

Design: Longitudinal retrospective cohort analysis of inpatient rehabilitation discharge data from the Washington State Department of Health Comprehensive Hospital Abstract Reporting System.

Setting: Inpatient rehabilitation.

Participants: Adults (N=56,382) who were discharged from inpatient rehabilitation in Washington State between 2001 and 2007.

Interventions: Not applicable.

Main Outcome Measures: Evidence of an established diagnosis of diabetes from *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) diagnosis codes; comorbid conditions reported in ICD-9-CM codes; LOS; and charges per stay.

Results: For all discharges from 2001 to 2007, diabetes prevalence was 17.8%; prevalence within specific impairment groups was 21.3% for the stroke subgroup, 14.2% for the orthopedic disorders subgroup, and 25% for the medically complex conditions subgroup. For all discharges, and within each impairment subgroup, prevalence did not change significantly from year to year. When adjusted for burden of nondiabetes comorbidities, LOS was significantly shorter for all discharges with diabetes younger than 65 years. The association between a diabetes codiagnosis and LOS in specific impairment groups was complex, ranging from a significantly shorter LOS for discharges with diabetes in the stroke subgroup to a finding of no significant difference in LOS among discharges with or without diabetes in the orthopedic impairments subgroup. Across all discharges, charges per day from 2003 to 2007 were significantly greater in discharges with diabetes. Within each specific impairment subgroup, charges per day across the entire study period were significantly greater for discharges with diabetes.

Conclusions: The high prevalence of diabetes, coupled with its impact on resource use, suggests that substantial pressures

may be placed on the inpatient rehabilitation care system to respond to the needs of those with diabetes.

Key Words: Comorbidity; Diabetes mellitus; Epidemiology; Rehabilitation.

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AN ESTIMATED 7.8% OF THE general United States population 20 years or older has diabetes, with 1 in 3 cases being undiagnosed.^{1,2} The prevalence of diabetes rises with age, exceeding 23% for those 60 years or older. Despite the high prevalence of diabetes, outpatient care for diabetes frequently falls short of recommended targets for disease management. Inadequate care can lead to serious cardiovascular, orthopedic, or neurologic complications that may require inpatient rehabilitation. Population-based cohort studies indicate that diabetes increases the relative risk for stroke or cardiac arrest.³⁻⁷ Once a stroke or cardiac event occurs, diabetes confers a significant adverse prognosis for morbidity and mortality, amplifying the need to tightly manage glycemia in the inpatient rehabilitation setting.⁸⁻¹³ Further, patients with cardiovascular events who were free of prevalent diabetes at the time of the event are at greater risk of subsequent new-onset diabetes, prediabetes, or insulin resistance.^{14,15} Diabetes is also associated with low-trauma hip fracture, for which an inpatient rehabilitation stay is common.¹⁶ Finally, diabetes is the leading cause of surgeries for lower-extremity amputations, which typically require an inpatient rehabilitation stay.² The current evidence points to the need for all facets of the inpatient continuum of care, inclusive of inpatient rehabilitation, to use aggressive strategies to detect undiagnosed diabetes and manage existing diabetes.

Although diabetes is not a primary impairment for which persons are admitted to inpatient rehabilitation, clinical experience suggests that the proportion of inpatient rehabilitation patients with diabetes is quite high. Yet, empirical estimates of the prevalence of diabetes in adults receiving inpatient rehabilitation are lacking. In addition, inpatient rehabilitation represents a point in the episode of care in which patients are readily available for remedial counseling, rescue education, and improved medication management for diabetes. A high

List of Abbreviations

ADA	American Diabetes Association
ANCOVA	analysis of covariance
CCI	Charlson Comorbidity Index
CHARS	Comprehensive Hospital Abstract Reporting System
ICD-9-CM	<i>International Classification of Diseases, 9th Revision, Clinical Modification</i>
IRF	inpatient rehabilitation facility
LOS	length of stay

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prevalence of diabetes would indicate the need for specific and ongoing training in diabetes management in health care providers who work in IRFs.

The purposes of this study were to determine the annual prevalence of diabetes as a codiagnosis and to examine the impact of diabetes on resource utilization in IRFs in Washington State for the years 2001 to 2007. Prevalence estimates of diabetes in the inpatient rehabilitation setting were calculated for the most common rehabilitation impairments, as well as for sex and age groups. The association between discharges with diabetes and discharges without diabetes on inpatient rehabilitation LOS and charges per day was also determined.

METHODS

Data Source

Data were obtained from the Washington State Department of Health Comprehensive Hospital Abstract Reporting System (<http://www.doh.wa.gov/ehsphl/hospdata/Chars.htm>). CHARS is a publicly available database used to collect information on all patients discharged from nonfederal facilities in the state of Washington. All community hospitals in the state of Washington, including IRFs, are required to report data to CHARS. As stated by the Washington State Department of Health, the purpose of the CHARS system is to provide public health personnel, consumers, purchasers, payers, providers, and researchers with useful information by which to make informed decisions on health care. CHARS data were captured from 22 facilities that carried the IRF designation for 2001 to 2004; in 2005, an additional facility was opened so that 2005 to 2007 data are based on 23 rehabilitation facilities.

Rehabilitation patients were classified by impairment group codes based on the primary reason for inpatient rehabilitation. Impairment group codes describe the impairments that serve as the general diagnostic categories for inpatient rehabilitation admission.^{17,18} IRFs categorize patients by impairment in order to group patients with similar resource use and likely LOS into case-mix groups.¹⁷⁻²⁰ For example, all types of stroke are assigned to the stroke impairment group code. The orthopedic disorders impairment group code includes cases in which the major disorder is postfracture of bone or postarthroplasty. Patients who require medical management of a principal condition requiring a prolonged recovery period to regain function, such as infections, neoplasms, circulatory disorders, respiratory disorders, and medical/surgical complications, are assigned to the medically complex conditions impairment group code. A listing of the 17 major impairment group codes can be found in [appendix 1](#) along with the frequency of occurrence of each impairment in the dataset. In the present study, patients were identified as a member of an impairment group when their ICD-9-CM principal etiologic code mapped to 1 of the 17 impairment groups.

Statistical Analysis

Annual prevalence was calculated as the percentage of discharged visits from an IRF for the years 2001 to 2007 with a diagnosis of diabetes or diabetes-related complications relative to all discharged visits from IRFs within that year. The CHARS record allows up to 9 ICD-9-CM diagnosis codes per patient; the specific ICD-9-CM codes used to determine whether a patient would qualify as positive for diabetes are listed in [appendix 2](#). Discharges with a diagnosis of either type 1 or type 2 diabetes were included. Specific prevalence per year was also calculated for each impairment group code as well as for each sex and for age group (<65 vs ≥65). The age of 65 was used

as the cut-point for forming age groups because this represents the age at which most citizens shift to Medicare as their source of health insurance. Comparing patients younger than 65 with those 65 or older provided an estimate of whether insurance source interacted with IRF admissions, and therefore prevalence estimates.

Polynomial trend tests were used to determine whether significant linear or nonlinear trends existed in diabetes prevalence data by year. When a significant trend was detected, Tamhane's T2 pairwise comparisons were performed to determine pairs of proportions that differed significantly. For all other prevalence analyses, chi-square analyses were used to explore differences among proportions, with Marascuilo contrast methods used to determine whether pairs of proportions differed significantly.

A comparison of LOS and medical costs per day among discharges with a secondary diagnosis of diabetes and discharges without a diabetes codiagnosis was accomplished with factorial general linear model analyses of covariance, with group (diabetes vs no diabetes), year (2001–2007), age group (<65 vs ≥65), and sex as independent variables. Statistical analysis by ANCOVA ensured that intergroup differences in potential confounding variables, in this case burden of comorbidities, were statistically equated when testing for differences among levels of the independent variables. An adjusted CCI score was calculated for each visit and used as the covariate. The CCI is a prototypical comorbidity scale that allows consistent quantification of comorbid conditions.^{21,22} The 19 conditions included in the index are weighted on a scale from 1 to 6 based on their association with mortality, with a summed CCI score derived after weighting. The CCI has been shown to correlate significantly with mortality, disability, acute care LOS, and readmission to acute care; all of these associations are indicative of good convergent predictive validity.^{22,23} The CCI was chosen over other scales that quantify the impact of comorbidity on clinical outcome because of the capability of CCI scoring algorithms to be applied to administrative datasets containing ICD-9-CM diagnosis and procedure codes. The scoring algorithm used was based on the work of Quan et al.²⁴ The adjusted CCI was derived by removing diabetes as a contributing condition to the calculation of the index. When the primary etiologic diagnosis represented 1 of the remaining 18 conditions typically used in the calculation of the index, it was included in the calculation of the adjusted CCI.

Of the 17 impairment group codes, 3 impairment conditions accounted for almost half of IRF total discharges and were, therefore, chosen for subgroup analyses. These were stroke (19% of all IRF discharges), orthopedic disorders (20.8% of all IRF discharges), and medically complex conditions (17.5% of all IRF discharges). Data from each subgroup were subjected to the aforementioned analyses.

In all analyses, the standard for judging statistical significance was a *P* value less than .01. Although more stringent than the common standard of a *P* value less than .05, the more conservative type I error rate protected against drawing inferences from analyses of a large data set that, although statistically significant, may not have been clinically important.

RESULTS

Frequency of discharges per year for demographic characteristics of the patients discharged from inpatient rehabilitation are displayed in [table 1](#).

Diabetes Prevalence in Inpatient Rehabilitation Facilities

Of the 56,382 total discharges from Washington State IRFs from 2001 to 2007, 10,016 discharges included a diabetes

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