

The Costs of Treating American Indian Adults With Diabetes Within the Indian Health Service

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Health disparities between American Indians and Alaska Natives and other racial/ethnic populations are well documented.¹⁻⁸ Some of the most notable disparities concern diabetes-related morbidity and mortality.⁹⁻²¹ American Indians and Alaska Natives have the highest prevalence of diabetes among all racial/ethnic groups in the United States. They are 2.3 times more likely to be diagnosed with diabetes than is the general US population, and in 2004 the prevalence of diabetes was 16.3% among American Indians and Alaska Natives aged 20 years and older.¹⁶ Mortality attributable to diabetes is 3 to 4 times higher among American Indians and Alaska Natives than among other racial/ethnic groups.^{11,6,20,21} Diabetes is the strongest predictor of cardiovascular disease (CVD) among American Indians,^{15,22,23} and coronary heart disease appears to be fatal more often among American Indians and Alaska Natives than among other populations.^{15,17,19}

American Indians and Alaska Natives have the highest rate of premature deaths from heart disease among all racial/ethnic groups,¹⁹ with a rate nearly 2.5 times the rate for Whites. Among American Indians and Alaska Natives, 36.0% of deaths from heart disease occur among persons younger than 65 years.¹⁹

The Indian Health Service (IHS) provides health services for nearly 2 million American Indians and Alaska Natives, both directly through IHS clinics and hospitals and indirectly through contracts and compacts with tribes and through funding for urban Indian health programs.²⁴ The medical needs of American Indians and Alaska Natives with diabetes are complex because diabetes in this population is characterized by early onset of type 2 diabetes and high rates of comorbidities (e.g., heart disease, kidney failure, lower-limb amputation).^{9-18,25,26} To address these needs the Special Diabetes Program for Indians provides funds to IHS and tribal organizations for diabetes prevention and treatment programs.²⁷ Since the program's implementation in 1997, intermediate

Objectives. We examined the costs of treating American Indian adults with diabetes within the Indian Health Service (IHS).

Methods. We extracted demographic and health service utilization data from the IHS electronic medical reporting system for 32 052 American Indian adults in central Arizona in 2004 and 2005. We derived treatment cost estimates from an IHS facility-specific cost report. We examined chronic condition prevalence, medical service utilization, and treatment costs for American Indians with and without diabetes.

Results. IHS treatment costs for the 10.9% of American Indian adults with diabetes accounted for 37.0% of all adult treatment costs. Persons with diabetes accounted for nearly half of all hospital days (excluding days for obstetrical care). Hospital inpatient service costs for those with diabetes accounted for 32.2% of all costs.

Conclusions. In this first study of treatment costs within the IHS, costs for American Indians with diabetes were found to consume a significant proportion of IHS resources. The findings give federal agencies and tribes critical information for resource allocation and policy formulation to reduce and eventually eliminate diabetes-related disparities between American Indians and Alaska Natives and other racial/ethnic populations. (*Am J Public Health.* 2012;102:301-308. doi:10.2105/AJPH.2011.300332)

clinical outcomes (e.g., blood glucose, blood pressure, cholesterol levels) among American Indians and Alaska Natives with diabetes have improved,²⁸ and the incidence of diabetes-related end-stage renal disease has decreased.⁹ However, stubbornly high rates of diabetes, related complications, and premature mortality among American Indians and Alaska Natives underscore the need to enhance prevention and treatment strategies. It is critical to understand health service utilization and treatment costs for American Indians and Alaska Natives with diabetes to effectively guide federal, IHS, and tribal efforts to reduce and eventually eliminate these disparities.

Although health service delivery, financing, and resource allocation are important determinants of health,^{27,29} little is known about health service utilization and treatment costs within IHS. Health service utilization and cost findings for US persons with diabetes are not generalizable to American Indians and Alaska Natives with diabetes because of disparities in other indicators of health status,^{1-5,8,9,19} access to

and use of health services,^{1,3-6,30} education,^{31,32} and income.^{31,32} To address this knowledge gap, we combined for the first time data from 3 different IHS reporting systems—the Resource Patient Management System (RPMS), Contract Health Services, and IHS cost reports—to describe health service utilization and IHS treatment costs for more than 30 000 American Indian adults with and without diabetes.

The study population lived in the Phoenix Service Unit, an IHS administrative unit located in central Arizona that includes reservations and rural, suburban, and urban areas. The service unit includes a large regional hospital, the Phoenix Indian Medical Center (PIMC), and several small community-based clinics dispersed throughout the region. Although there is diversity across the IHS in the prevalence of diabetes and health service delivery systems, use of data from this service unit provides an initial opportunity to examine relationships among health status, utilization, and treatment costs.

METHODS

The Phoenix Service Unit uses the RPMS, a unified electronic medical record and registration system that provides detailed administrative and clinic information. Similar to administrative data for health plans, RPMS data include information about medical procedures, diagnostic codes, use of prescribed medications, and laboratory test values for inpatient and outpatient services. The RPMS data quality and performance are comparable to those of private health insurance plans.³³

Study Population

The study population included 32 052 American Indians aged 18 years and older who were active IHS users between October 1, 2004, and September 30, 2005 (fiscal year [FY] 2005), and who reported the Phoenix Service Unit as their community of residence during FY 2005. The IHS definition of an active user during a fiscal year is a person who had at least 1 outpatient visit during 1 of the past 3 fiscal years (FY 2003–FY 2005 in this study). The IHS Phoenix Area and the University of Colorado Denver's institutional review boards approved the study protocol.

Data

We extracted data on demographic characteristics, third-party health coverage, use of IHS hospital inpatient services, use of IHS hospital outpatient services, and prescribed medications for FY 2005 from the RPMS. Eligibility for IHS services is determined by tribal membership. The IHS maintains information on third-party health coverage (e.g., Medicaid, Medicare, and private insurance) because the IHS may file for reimbursement for services provided for American Indians and Alaska Natives with such coverage. The data included information for IHS services obtained throughout Arizona, Utah, Nevada, and California. Reimbursement by IHS for services not provided at IHS facilities was provided through IHS Contract Health Services. We obtained administrative data on Contract Health Service utilization and payments from the IHS fiscal intermediary for this region, Blue Cross Blue Shield New Mexico.

Cost estimates for all services provided at IHS facilities were derived from the FY 2005

PIMC cost report. Less than 5% of IHS medical service utilization occurred at facilities other than the PIMC, and we assumed treatment costs at these facilities were similar to those of the PIMC. Each year, IHS facilities that operate inpatient units prepare cost reports for the Centers for Medicare and Medicaid Services by using a cost-accounting process developed by the US Office of Management and Budget. Data from cost reports for IHS facilities throughout the United States are combined to determine the Medicare and Medicaid national reimbursement rates for IHS providers for 3 types of services (i.e., a dental or optometry visit, a visit for other outpatient services, and a hospital inpatient day). We used data specific to the PIMC cost report to estimate the costs of specific types of services within the Phoenix Service Unit.

Analysis

We used SAS software version 9.2 (SAS Institute, Cary, NC) for variable construction and statistical analyses. We assessed the prevalence of health conditions (e.g., diabetes, CVD) by using a Diagnostic Cost Group (DCG) model embedded in Risksmart software version 2.1 (Verisk Healthcare, Boston, MA). The DCGs classify the *International Classification of Diseases 9th Revision Clinical Modification (ICD-9-CM)* diagnostic codes recorded on inpatient and outpatient service records into condition categories relevant for assessing morbidity and treatment costs.³⁴ We selected DCGs for this purpose because federal agencies (e.g., the Centers for Medicare and Medicaid Services and the Agency for Healthcare Research and Quality), state governments, and commercial insurance companies use DCG models to assess the disease burden of populations.^{35–37}

For each person, we calculated the total number of hospital admissions, hospital inpatient days, and outpatient visits by using RPMS and Contract Health Service data. We categorized IHS-provided outpatient visits, using RPMS clinic codes, into 8 categories: emergency department (ED), primary care, specialty care, ophthalmology and optometry (eye care), podiatry (foot care), dental, behavioral health, and education or care management.

We derived treatment cost estimates for IHS-provided services from the PIMC cost report. The cost report documented all costs for

physician, midlevel, nursing, and other health providers, including salaries, benefits, and training costs; ancillary services (e.g., laboratory and radiology services); pharmacy services, including prescribed medications, medical supplies (e.g., glucose monitors), and dispensing services; other supplies; capital and operating expenditures for equipment; and administrative services at the local, regional, and national level. The cost report data included detailed information on health provider clinic assignments and facility costs (e.g., equipment, heating) of operating specific clinics. We used RPMS medical and pharmacy utilization data and other data to allocate the majority of these costs to specific service types. We used the expert opinions of IHS fiscal and medical personnel to guide allocations of some costs (e.g., ancillary costs, supplies) across service types when data were not available.

The average cost estimates for the medical services were: inpatient hospital day, \$2318; ED visit, \$296; primary care visit, \$280; specialty care visit, \$459; eye care visit, \$176; foot care visit, \$303; dental visit, \$222; behavioral health visit, \$174; and education or care management visit, \$497. The average cost of a prescribed medication, or medical supply obtained from the pharmacy, was \$46. It is worth noting that within the study site, ED visits include emergency, urgent care, and unscheduled (walk-in) visits for acute health problems, whereas adult primary care visits are generally visits for chronic care management. Consequently, the average costs of ED and primary care visits at the study site do not vary as much as in some other health systems.

For each adult, we multiplied the number of inpatient hospital days, outpatient visits, and prescribed medications by the respective cost estimate to obtain the treatment cost for each type of IHS-provided service. These cost estimates were added to any IHS payments for Contract Health Services to estimate the total IHS treatment cost for each adult.

RESULTS

Our study population was 57.6% female and 42.4% male. The proportion of participants aged 65 years and older was 3.5%. Approximately 46% of the population had at least 1 type of third-party coverage. Nearly 38% had

1 or more forms of public-sector health coverage, with 31.4%, 5.7%, and 3.2% reporting Medicaid, Medicare, and Veterans Administration coverage or eligibility, respectively. Twelve percent reported private-sector health insurance.

The prevalence of diabetes was 10.9%, ranging from 3.9% among those aged 18 to 34 years to 40.3% among those aged 65 to 74 years (Table 1). Although the prevalence of diabetes among participants aged 65 years and older was high, they accounted for only 12.0% of all participants with diabetes. About half of the participants with diabetes were aged 35 to 54 years.

As shown in Table 2, the prevalence of other chronic conditions among American Indian adults with diabetes was high. Two thirds of adults with diabetes had hypertension, and 19.0% had CVD. The prevalence of renal

failure among those with diabetes was 6.3%; one fifth had a mental health disorder. Rates of substance use disorders and liver disease were 10.7% and 6.8%, respectively, among American Indian adults with diabetes.

Information on medical and pharmacy service utilization is provided in Table 3. The average number of visits for adults with diabetes was 1.84 for the emergency department, 4.07 for primary care, 0.94 for specialty care, 1.07 for eye care, 0.99 for foot care, 1.44 for dental, 0.52 for behavioral health, and 0.69 for education or care management during the 12-month period. Utilization rates for ED, primary care, specialty, and dental services for adults with diabetes were 2 to 3 times higher than were rates for persons without diabetes; the ratio for behavioral health services was 1.5.

Annual hospital inpatient service utilization, inclusive of Contract Health Service utilization,

by those with diabetes averaged 1.25 days. Utilization by those with diabetes was approximately 5 times higher than that of those without diabetes, when we adjusted for age and gender differences. Although not shown in Table 3, nearly half (47.6%) of IHS hospital days, excluding those for obstetrical care, were accounted for by persons with diabetes. Furthermore, persons with both diabetes and CVD accounted for 21.7% of all hospital days.

The average annual treatment cost for adults with diabetes was estimated to be \$7682 (Table 4). Annual treatment costs were less than \$1000 for 8.6% of American Indians with diabetes; 48.6% had costs from \$1000 to \$4999, 24.6% from \$5000 to \$9999, 13.5% from \$10 000 to \$24 999, and 4.7% had costs \$25 000 and greater. Costs increased with age; average costs for American Indians with diabetes were \$7001, \$8077, and \$8785, respectively, for those aged 18 to 44 years, 45 to 64 years, and 65 years and older.

Hospital inpatient service costs accounted for 32.2% of all treatment costs for those with diabetes. Among American Indians with both diabetes and CVD, hospital inpatient services accounted for 43.1% of all treatment costs; the percentage for those with diabetes but not CVD was 26.9% (Table 5). Pharmacy costs for American Indians with both conditions were 1.4 times higher than those for those with diabetes but not CVD.

Treatment costs for adults with diabetes accounted for more than one third (37.0%) of treatment costs of all adults. Annual treatment costs for adults with both diabetes and CVD were estimated to be \$13 346, approximately twice those of adults with diabetes but no CVD.

DISCUSSION

The diabetes epidemic among American Indians and Alaska Natives is likely attributable to a complex array of factors and has emerged over multiple decades.^{38,39} Reversal of this trend will likely require a sustained, multi-pronged approach and will be further challenged by shortages of health care professionals, funding limitations, and geographic barriers in terms of provider location and transportation costs.^{5,30,32,40-42} This study gives Congress, IHS, and tribes critical information about current use of IHS resources for the

TABLE 1—Prevalence of Diabetes Among American Indian Adults: US Indian Health Service, Phoenix Service Unit, Arizona, October 1, 2004–September 30, 2005

	All Adults, No. (Column %)	Adults With Diabetes	
		No. (Row %)	95% CI
Women, age in y			
18-34	10881 (58.9)	477 (4.4)	4.0, 4.8
35-44	3653 (19.8)	484 (13.2)	12.1, 14.3
45-54	2157 (11.7)	547 (25.4)	23.5, 27.2
55-64	1049 (5.7)	390 (37.2)	34.2, 40.1
65-74	479 (2.6)	195 (40.7)	36.3, 45.1
≥75	243 (1.3)	84 (34.6)	28.5, 40.6
All ages	18462 (100.0)	2177 (11.8)	11.3, 12.3
Men, age in y			
18-34	7978 (58.7)	252 (3.2)	2.8, 3.5
35-44	2949 (21.7)	345 (11.7)	10.5, 12.9
45-54	1580 (11.6)	340 (21.5)	19.5, 23.5
55-64	692 (5.1)	241 (34.8)	31.3, 38.4
65-74	281 (2.1)	111 (39.5)	33.8, 45.3
≥75	110 (0.8)	28 (25.5)	17.2, 33.7
All ages	13590 (100.0)	1317 (9.7)	9.2, 10.2
Both genders, age in y			
18-34	18859 (58.8)	729 (3.9)	3.6, 4.1
35-44	6602 (20.6)	829 (12.6)	11.8, 13.4
45-54	3737 (11.7)	887 (23.7)	22.4, 25.1
55-64	1741 (5.4)	631 (36.2)	34.0, 38.5
65-74	760 (2.4)	306 (40.3)	36.8, 43.8
≥75	353 (1.1)	112 (31.7)	26.8, 36.6
All ages	32052 (100.0)	3494 (10.9)	10.6, 11.2

Note. CI = confidence interval.

TABLE 2—Prevalence of Selected Health Conditions Among American Indian Adults, by Diabetes Status: US Indian Health Service, Phoenix Service Unit, Arizona, October 1, 2004–September 30, 2005

Condition	All Adults, % (95% CI)	Adults With Diabetes, % (95% CI)	Adults Without Diabetes, % (95% CI)	Adults With Diabetes Compared With Adults Without Diabetes, OR (95% CI)
Hypertension	13.3 (13.0, 13.7)	65.7 (64.1, 67.3)	6.9 (6.6, 7.2)	16.1 (14.7, 17.6)
All cardiovascular conditions	4.4 (4.2, 4.6)	19.0 (17.7, 20.3)	2.6 (2.4, 2.8)	4.4 (3.9, 5.0)
Ischemic heart disease	1.5 (1.4, 1.6)	8.0 (7.1, 8.9)	0.7 (0.6, 0.8)	5.7 (4.7, 7.0)
All forms heart disease	1.9 (1.8, 2.1)	8.0 (7.06, 8.85)	1.2 (1.1, 1.3)	3.7 (3.1, 4.4)
Cerebrovascular disease	2.2 (2.0, 2.3)	9.8 (8.8, 10.8)	1.2 (1.1, 1.3)	4.4 (3.7, 5.2)
Renal failure	1.0 (0.9, 1.1)	6.3 (5.5, 7.1)	0.4 (0.3, 0.5)	10.5 (8.1, 13.5)
Neuropathy	5.0 (4.8, 5.2)	19.8 (18.5, 21.1)	3.2 (3.0, 3.4)	4.9 (4.4, 5.5)
Amputations	0.3 (0.3, 0.4)	2.5 (2.0, 3.0)	0.0	40.6 (21.1, 78.2)
Mental health conditions	9.4 (9.1, 9.7)	20.5 (19.2, 21.8)	8.0 (7.7, 8.3)	2.3 (2.0, 2.5)
Substance abuse disorders	5.7 (5.4, 6.0)	10.7 (9.7, 11.8)	5.1 (4.8, 5.3)	2.2 (1.9, 2.5)
Liver disease	2.6 (2.4, 2.7)	6.8 (6.0, 7.7)	2.0 (1.9, 2.2)	2.5 (2.1, 3.0)

Note. CI=confidence interval; OR=odds ratio. Odds ratio controls for age and gender differences between adults with and without diabetes.

treatment of diabetes and can inform discussions of resource allocation and policies that will be necessary to improve health outcomes among American Indians and Alaska Natives with diabetes.

Drawing upon data for more than 30 000 American Indian adults who resided in central Arizona, we found that those with diabetes had, on average, 2 ED visits and spent 1.25 days in the hospital during a 12-month period. Nearly half of all hospital days, excluding those for obstetrical care, were accounted for by persons with diabetes. To reduce avoidable hospitalizations and improve health outcomes, additional research must be conducted to better understand the relationships among age, comorbidities, and utilization of health prevention, pharmacy, and other outpatient services by American Indians and Alaska Natives with diabetes. This understanding is particularly important in light of the high rates of comorbidities among American Indians and Alaska Natives with diabetes. Studies of other racial/ethnic populations indicate that less access to and lower use of specific types of services (e.g., medications, diagnostic tests, surgeries) contribute to poorer health outcomes.^{43,44} Improvements in understanding of the prevention and treatment of stroke, hypertension, and ischemic heart disease among American Indians and Alaska Natives with diabetes could lead to reductions in related morbidity and mortality,

similar to those observed in the non-Hispanic White population.^{15,17,19,21,45,46}

These findings highlight the need to expand and adopt evidence-based practices to prevent and treat diabetes among American Indians and Alaska Natives. The annual budget for IHS during FY 2010 was approximately \$4.7 billion, a per capita expenditure of \$2500.^{24,47} Included in the budget is \$150 million for the Special Diabetes Program for Indians (SDPI).⁴⁷ The SDPI funded nearly 400 diabetes treatment and prevention programs intended to implement key elements of quality diabetes care and prevention practices using traditional and culturally relevant approaches, as well as to participate in annual evaluations to monitor the quality of service delivery.^{16,28,48–50} For example, the SDPI currently funds 38 initiatives to evaluate the feasibility of providing evidence-based diabetes prevention programs modeled after the national Diabetes Prevention Program.^{50,51} The IHS continues to evaluate other options for translation of evidence-based practices.

In this study, a high proportion of IHS service utilization and treatment costs was attributable to adults with diabetes. Approximately 1 of every 3 IHS dollars spent on treatment was for services for adults with diabetes. The IHS treatment costs for the 10.9% of adults with diabetes accounted for 37.0% of all adult treatment costs. Consequently, it is

important to examine how IHS expenditures for diabetes-related care may indirectly influence the availability of resources for treating other conditions within the IHS and how improvements in diabetes treatment may alter this relationship.

To place these findings in a broader perspective, we compared IHS treatment costs for diabetes to estimates for the US population. The American Diabetes Association (ADA) estimated that the 5.8% of US population with diabetes (all ages) accounted for 19.1% of all medical and pharmacy costs for US persons in 2007 (excluding costs of institutional nursing and residential services),⁵² a finding similar to that from the 2003 Medical Expenditure Panel Survey.⁵³ In our study, FY 2005 treatment costs for American Indian adults with diabetes averaged \$7682, 3.6 times those of American Indian adults without diabetes. The IHS relative spending for those with and without diabetes differs from that reported in the ADA study, in which the average annual costs for those with diabetes (excluding costs of institutional nursing and residential services) were approximately \$10700; but this figure was only 2.4 times higher than costs for those without diabetes.⁵² Differences in health resource consumption between American Indians with diabetes and US persons with diabetes may be attributable to differences in age of onset, prevalence of comorbidities,⁵⁴ utilization of primary and specialty services, health system treatment costs,

TABLE 3— American Indian Adults' Utilization of Medical and Pharmacy Services, by Diabetes Status: US Indian Health Service, Phoenix Service Unit, Arizona, October 1, 2004–September 30, 2005

	All Adults		Adults With Diabetes		Adults Without Diabetes		
	No.	Utilization Rate (95% CI)	No.	Utilization Rate (95% CI)	No.	Utilization Rate	Adjusted Utilization Rate (95% CI)
Indian Health Service providers							
Inpatient hospital							
Admissions	1836	0.06 (0.05, 0.06)	548	0.16 (0.14, 0.17)	1288	0.05	0.05 (0.045, 0.051)
Days	7718	0.24 (0.22, 0.26)	3198	0.92 (0.78, 1.05)	4520	0.16	0.22 (0.20, 0.23)
Mean length of stay, d		4.20 (4.19, 4.22)		5.84 (5.81, 5.86)		3.51	4.50 (4.48, 4.52)
Outpatient							
Emergency	34 103	1.06 (1.04, 1.08)	6418	1.84 (1.75, 1.92)	27 685	0.97	0.94 (0.92, 0.95)
Primary care	43 371	1.35 (1.32, 1.39)	14 205	4.07 (3.91, 4.22)	29 166	1.02	1.34 (1.31, 1.37)
Specialty care	10 245	0.32 (0.31, 0.33)	3 289	0.94 (0.87, 1.02)	6 956	0.24	0.37 (0.36, 0.38)
Eye care	9 183	0.29 (0.28, 0.30)	3 729	1.07 (1.01, 1.12)	5 454	0.19	0.29 (0.28, 0.30)
Foot care	6 525	0.20 (0.19, 0.22)	3 447	0.99 (0.91, 1.07)	3 078	0.11	0.16 (0.15, 0.17)
Dental	17 738	0.55 (0.53, 0.57)	5 043	1.44 (1.35, 1.53)	12 695	0.44	0.52 (0.50, 0.53)
Behavioral health	10 193	0.32 (0.30, 0.34)	1 831	0.52 (0.43, 0.62)	8 362	0.29	0.35 (0.32, 0.37)
Education or care management	3 062	0.10 (0.09, 0.10)	2 421	0.69 (0.65, 0.74)	641	0.02	0.02 (0.02, 0.03)
All services	134 420	4.19 (4.12, 4.27)	40 383	11.56 (11.21, 11.91)	94 037	3.29	3.98 (3.92, 4.05)
Pharmacy: prescriptions and supplies	228 109	7.12 (6.95, 7.29)	102 832	29.43 (28.55, 30.31)	125 277	4.39	7.45 (7.33, 7.57)
Contract health service providers							
Inpatient hospital							
Admissions	354	0.01 (0.01, 0.01)	186	0.05 (0.04, 0.06)	168	0.01	0.01 (0.01, 0.01)
Days	1 899	0.06 (0.05, 0.07)	1 175	0.34 (0.24, 0.43)	724	0.03	0.04 (0.03, 0.05)
Mean length of stay, d		5.36 (5.33, 5.40)		6.32 (6.27, 6.36)		4.31	4.30 (4.25, 4.35)
Outpatient: all services	17 928	0.56 (0.45, 0.67)	10 525	3.01 (2.20, 3.82)	7 403	0.26	0.34 (0.28, 0.41)
All providers							
Inpatient hospital							
Admissions	2 190	0.068 (0.065, 0.072)	734	0.21 (0.19, 0.23)	1 456	0.05	0.057 (0.054, 0.060)
Days	9 617	0.30 (0.28, 0.32)	4 373	1.25 (1.08, 1.42)	5 244	0.18	0.26 (0.24, 0.27)
Mean length of stay, d		4.39 (4.38, 4.41)		5.96 (5.93, 5.98)		3.60	4.50 (4.48, 4.52)
Outpatient: all services	152 348	4.75 (4.62, 4.88)	50 908	14.57 (13.70, 15.44)	101 440	3.55	4.33 (4.24, 4.42)

Note. CI = confidence interval. Numbers may not sum to totals because of rounding. Direct adjustment was used to adjust the mean for differences in age and gender between adults with and without diabetes.

undocumented health service costs for American Indians, and premature mortality. For example, only 12.0% of adult IHS active users with diabetes in the Phoenix Service Area were aged 65 years or older, whereas in the ADA study, 38.5% of US adults with diabetes were estimated to be aged 65 years and older.⁵²

This study has a number of strengths. It is the first to link existing electronic data on health service utilization from the RPMS and Contract Health Services with existing cost report data to provide the IHS with detailed treatment cost estimates for a large American Indian adult population. The study location serves one of the largest populations in the IHS system and

provides a wide range of health services. Rather than deriving service cost estimates from negotiated prices or insurance reimbursement, we used actual facility-specific operating costs as the basis for service cost estimates. Although the IHS compiles cost reports to set national reimbursement rates for Medicaid and Medicare services, these detailed financial data have not been employed previously to estimate costs for specific types of outpatient services, including pharmacy services.

There are also several limitations to this study that are important to note. First, the study included data only for IHS active users. Still, they represent nearly two thirds of persons

ever registered for IHS services and reported to live in the service unit.^{31,55} The IHS active users are persons who had at least 1 outpatient visit during the past 3 years; consequently, they were more likely to have poorer health and to be female than were those who did not use services. The low percentage of American Indian adults aged 65 years and older (3.5%) in the study population may be explained by disparities in life expectancy between American Indians and Alaska Natives and other populations and demographic characteristics of the Phoenix metropolitan area.^{1,31} The availability of schools and employment opportunities in the service unit contributes to local rural-to-urban migration by

TABLE 4—US Indian Health Service Treatment Costs for American Indian Adults, by Diabetes Status: US Indian Health Service, Phoenix Service Unit, Arizona, October 1, 2004–September 30, 2005

	All Adults		Adults With Diabetes		Adults Without Diabetes		
	Total Costs, \$	Mean Costs, \$ (95% CI)	Total Costs, \$	Mean Costs, \$ (95% CI)	Total Costs, \$	Mean Costs, \$	Adjusted Mean Costs, \$ (95% CI) ^a
Indian Health Service providers							
Inpatient hospital	17 890 324	558 (509, 607)	7 412 964	2122 (1798, 2445)	10 477 360	367	505 (468, 542)
Outpatient							
Emergency	10 094 488	315 (309, 321)	1 899 728	544 (519, 569)	8 194 760	287	277 (271, 283)
Primary care	12 143 880	379 (369, 388)	3 977 400	1138 (1094, 1183)	8 166 480	286	376 (368, 384)
Specialty care	4 702 455	147 (141, 153)	1 509 651	432 (397, 467)	3 192 804	112	170 (164, 176)
Eye care	1 616 208	50 (49, 52)	656 304	188 (179, 197)	959 904	34	51 (49, 53)
Foot care	1 977 075	62 (58, 65)	1 044 441	299 (275, 323)	932 634	33	48 (46, 50)
Dental	3 937 836	123 (119, 127)	1 119 546	320 (300, 340)	2 818 290	99	115 (111, 119)
Behavioral health	1 773 582	55 (52, 59)	318 594	91 (75, 107)	1 454 988	51	60 (56, 64)
Education or care management	1 294 387	40 (38, 43)	1 059 703	303 (282, 325)	234 684	8	9 (8, 10)
All outpatient services	37 539 911	1171 (1151, 1192)	11 585 367	3316 (3213, 3419)	25 954 544	909	1107 (1089, 1125)
Pharmacy: prescriptions and supplies	10 493 014	327 (320, 335)	4 730 272	1354 (1313, 1394)	5 762 742	202	343 (337, 349)
All services	65 923 249	2057 (1993, 2121)	23 728 603	6791 (6394, 7189)	42 194 646	1478	1955 (1906, 2004)
Contract health service providers							
Inpatient hospital	2 596 222	81 (61, 101)	1 234 474	353 (213, 493)	1 361 748	48	74 (58, 90)
Outpatient	4 081 191	127 (113, 142)	1 876 925	537 (429, 646)	2 204 266	77	111 (101, 121)
All services	6 677 413	208 (180, 237)	3 111 399	890 (687, 1094)	3 566 014	125	185 (165, 205)
All providers							
Inpatient hospital	20 486 546	639 (586, 692)	8 647 438	2475 (2124, 2826)	11 839 108	415	579 (540, 618)
Outpatient	41 621 102	1299 (1273, 1324)	13 462 292	3853 (3706, 4000)	28 158 810	986	1218 (1198, 1238)
Pharmacy	10 493 014	327 (320, 335)	4 730 272	1354 (1313, 1394)	5 762 742	202	343 (337, 349)
All services	72 600 662	2265 (2194, 2336)	26 840 002	7682 (7239, 8124)	45 760 660	1602	2140 (2087, 2193)
Row %	100.0		37.0		63.0		

Note. CI = confidence interval. Numbers may not sum to totals because of rounding.
^aWe used direct adjustment to adjust the mean for differences in age and gender between adults with and without diabetes.

younger American Indians and to a high proportion of persons younger than 65 years living in the service unit.

Second, we had data for services obtained at non-IHS facilities only if the IHS provided reimbursement for the services through Contract Health Services. Consequently, we did not have data for services provided at non-IHS facilities if the IHS did not provide reimbursement for them. With approximately 46% of American Indians in this study having at least 1 other type of health coverage, the findings presented in Tables 3 through 5 most likely underestimate total service utilization and costs for the study population. For example, if an adult with Medicare coverage obtained services from a non-IHS provider, the IHS would not have a record of the service.

Because the objective of this study was to examine service use and treatment costs within the IHS, we believe these 2 limitations do not adversely impact the implications of this study.

Third, these findings were based on data for a single 12-month period and most likely underestimated the actual prevalence of diabetes and other chronic conditions. Fourth, we were not able to use our utilization and cost data to estimate the costs of specific types of medical procedures and medications. The actual average cost of an outpatient visit or inpatient stay by a person with diabetes may be higher than that for a person without diabetes. Thus, estimates for American Indians with diabetes may underestimate actual costs, whereas actual costs for

American Indians without diabetes may be overestimated. Fifth, health costs have increased since 2005. However, we believe the findings concerning service utilization patterns and relative costs among American Indian adults and between American Indian adults and the general US population remain relevant.

Finally, this study provides important utilization and treatment cost information for more than 32 000 American Indians. However, there are more than 550 federally recognized tribes throughout the United States.³¹ Tribal variations in culture, traditions, history, and the prevalence of diabetes are well documented,^{12,16,31,56,57} and our results may not be generalizable to other groups of American Indians and Alaska Natives. Although it is beyond

TABLE 5—US Indian Health Service Treatment Costs for American Indian Adults With Diabetes, by CVD Status: US Indian Health Service, Phoenix Service Unit, Arizona, October 1, 2004–September 30, 2005

	Adults With Diabetes and CVD		Adults With Diabetes but No CVD		
	Total Costs, \$	Mean Costs, \$ (95% CI)	Total Costs, \$	Mean Costs, \$	Adjusted Mean Costs, \$ (95% CI) ^a
Inpatient hospital	3 819 008	5752 (4481, 7022)	4 828 430	1706	1628 (1320, 1936)
Outpatient	3 757 602	5659 (5243, 6075)	9 704 690	3429	3384 (3235, 3533)
Pharmacy	1 285 240	1936 (1820, 2051)	3 445 032	1217	1353 (1312, 1394)
All services	8 861 850	13 346 (11 829, 14 864)	17 978 152	6353	6366 (5966, 6766)
Row %	33.0 ^b		67.0 ^b		

Note. CVD = cardiovascular disease. CVD includes ischemic heart disease, other forms of heart disease, and cerebrovascular disease.

^aWe used direct adjustment to adjust the mean for differences in age and gender between adults with and without CVD.

^bAmong those with diabetes.

the scope of this study, such limitations should be addressed in future research.

This study is an important first step in understanding health service utilization patterns and treatment costs for American Indians and Alaska Natives with diabetes, but it also clearly points to the need for additional analyses. Studies that examine data on a broader array of American Indians and Alaska Natives and that include detailed data on medical and pharmacy utilization and costs may be used to inform policies and enhance services to reduce and eventually eliminate diabetes-related disparities between American Indians and Alaska Natives and other racial/ethnic populations. ■

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Contributors

J.M. O'Connell, C. Wilson, S.M. Manson, and K.J. Acton contributed to study design, data interpretation, and writing. J.M. O'Connell and C. Wilson conceptualized the study. J.M. O'Connell analyzed the medical and financial data.

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Human Participant Protection

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