

Funding of Tribal Health Programs Linked to Lower Rates of Hospitalization for Conditions Sensitive to Ambulatory Care

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Objective: To determine first whether higher funding of Tribally Operated Health Programs (TOHP) is associated with reduced hospitalizations for ambulatory care sensitive conditions (HASC) of the American Indian/Alaska Natives (AIAN) who use them after adjusting for characteristics of TOHP service areas; and then whether improved ambulatory care with higher levels of funding mediates the association.

Research Design: Records in the Indian Health Service (IHS) for California of an annual average 42,153 AIAN users of TOHP from 1998 to 2002 were linked with state hospital discharge records. We analyzed 3181 HASC for AIAN users of 20 TOHP in multilevel Poisson regression models to determine the association of HASC rates adjusted for individual age and gender with the Federal Disparity Index for IHS funding of TOHP.

Results: Higher IHS funding of TOHP was associated with lower HASC rates for the AIAN who use them. For TOHP with less than 60% of health care costs funded, the HASC rate dropped 12% for every increase of 10% in funding. Even adjusting for characteristics of the service areas, the effect was only slightly reduced to a value of 9% to 11%. None of the available indicators of ambulatory care tested were found to mediate the effects.

Conclusions: Our findings are consistent with a policy of IHS funding of all TOHP at a level of at least 60% of the health care costs of the AIAN who use the programs, instead of the current policy of 40%. Additional research is needed to understand what ambulatory care characteristics are improved by the funding.

Key Words: American Indians and Alaska Natives, Indian Health Service, outcomes, health care coverage, rural health

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Providing medical care to American Indians and Alaska Natives (AIAN) who are eligible for care through the Indian Health Service (IHS) has increasingly become the

responsibility of tribes. Tribally Operated Health Programs (TOHP) provide care nationally to more than one-third of the 1.8 million AIAN who obtain services from the IHS.¹ They have become the largest sector of IHS healthcare organizations with 216 ambulatory care centers, 162 Alaska village clinics, and 15 hospitals in 35 states.^{2,3} The growth of TOHP, however, occurred even though there has been a steady decline in funding of health care provided through IHS.⁴ In 1999, the IHS found that their funding covered only 51% of medical services.⁵ A workgroup of AIAN health leaders met with actuaries to develop and apply a model to determine what it would cost to equitably fund health care services to users of TOHP and other IHS service units on a per capita basis. The model used the Federal Employees Health Plan as benchmark benefits and costs against which government-funded medical services of IHS-eligible AIAN beneficiaries were compared. The extent to which the IHS-funded TOHP nationally varied from less than 20% to more than 100% of the benchmark costs of care. It is the purpose of this study to investigate whether this variation in IHS funding of medical services provided by TOHP is associated with poor health outcomes of the AIAN who use them in California.

All TOHP provide primary care medical services, but the extent to which they provide specialty or hospital care varies considerably.^{6,7} In California, TOHP provide care to nearly 90% of the 81,300 AIAN served by IHS-funded healthcare system, the remaining 10% obtain care from urban programs.¹ There are 24 TOHP operated by tribes and tribal consortia in rural underserved low-income areas that include more than 50 ambulatory care clinics.^{8,9} There are no IHS or tribal hospitals in California. The TOHP provide comprehensive primary care themselves and arrange for specialty care and hospitalizations as funds allow. Less than 49% of medical services provided by TOHP in California are covered by IHS funding,⁵ and only about 100 of more than 4000 hospitalizations a year are paid with IHS funds.⁹ Although much is made in the media of the aura of wealth surrounding Indian tribes that establish gaming casinos, and while some tribal members have become wealthy in California as a result of gaming, the majority have not. Despite Indian gaming, disparities with whites persist in income, poverty rates, and public assistance.¹⁰

The Institute of Medicine recommended the use of hospitalizations for ambulatory care-sensitive conditions (HASC) as an indicator of unmet needs for care in popula-

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tions,¹¹ particularly for vulnerable populations.¹²⁻¹⁴ Timely access to effective ambulatory care should prevent some conditions, control acute episodes of others, and manage chronic illness so that hospitalizations for these conditions are not necessary.¹⁵ One of the intended uses of the HASC indicator from the beginning was to improve the identification of areas that were underserved by health care providers and in need of special government support in the form of clinics or other programs.¹⁶ It is thus not surprising that HASC have become a common health outcome indicator for state and federal governments to monitor how effectively ambulatory care meets the needs of various populations.¹⁶⁻¹⁹ The availability and use of primary care clinics have been shown to be associated with lower rates of HASC in vulnerable populations,^{20,21} although in rural areas these effects have been more difficult to demonstrate.^{22,23}

In this study we test whether HASC outcomes of ambulatory care provided by TOHP in California depend on how well the TOHP are funded by the IHS. The main hypothesis is that the higher the funding, the lower the HASC rates of the AIAN who receive the ambulatory care. It is

further hypothesized that the funding effect is mediated by the ambulatory care that TOHP provide. The conceptual framework for specifying the models is guided by economic theory in which the “supply” of TOHP ambulatory care in volume, type, and quality depends on IHS funding adjusted for local medical price inflation, and then the greater the supply of ambulatory care provided, the better the HASC outcomes (Fig. 1).^{20,24} The potentially confounding characteristics to be adjusted are the characteristics of “demand” for TOHP care. Greater demand for care under comparable supply characteristics could reduce the impact of care on the outcomes. Demand, or use of care, depends on the size and health status of the population eligible for care, and on community contextual factors that influence how readily the population can obtain care. Community contextual variables such as low socioeconomic status and a lack of availability of transportation or telephone service could reduce demand for ambulatory care and have a negative effect on outcomes. We first test the association between the IHS funding and the outcome, and then identify which demand factors are associated with the outcome, and therefore might confound the association of the funding with the outcome. We then determine whether or not the IHS funding is still associated with the outcome after adjusting for confounding characteristics. Finally, we test whether supply characteristics of TOHP care mediate the association between the funding and the outcome in the demand-adjusted models.

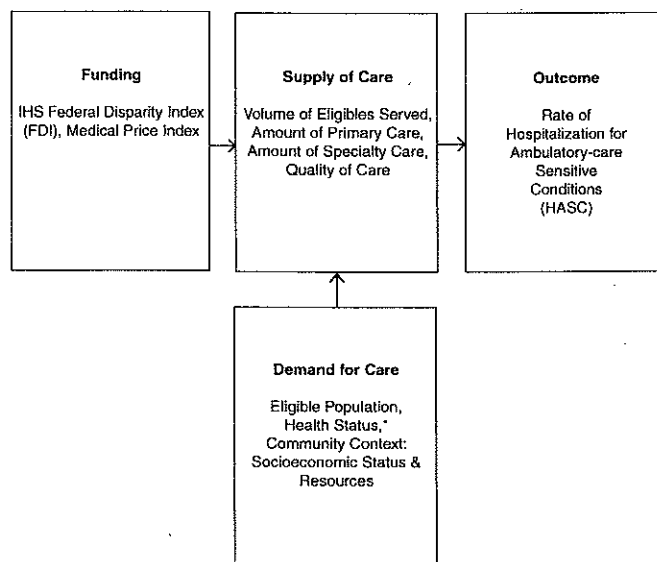


FIGURE 1. Conceptual framework of the pathways by which IHS funding of TOHP could affect health outcomes. In the framework the supply of TOHP ambulatory care in volume (user population), type (primary or specialty care) and quality (performance measures) increases with IHS funding adjusted for local medical price inflation. The greater the supply of care provided the better the outcomes. The potentially confounding characteristics of demand for care include: the size (service population) and health status (no data available for testing) of the population eligible for care, and the community contextual factors that decrease how readily the population can obtain care. The greater the demand for care, or the lower the ability to obtain care, the poorer the outcomes. Contextual measures used include indicators of low socioeconomic status (income, gaming revenues) and a lack of resources for obtaining care (vehicles for transportation, telephone service for communication with the TOHP, or large families with a high number of occupants per room).

METHODS

Data Sources

California hospital discharge data for nonfederal, short-stay hospitals from 1998 to 2002 was linked to the IHS National Patient Information Reporting System data of AIAN “Active” Users for California by the California Department of Health Services using Social Security Number (SSN).⁹ Protection of human subjects was approved by institutional review boards of the California Department of Health Services, the California Rural Indian Health Board, and the University of California San Francisco. An Active User is defined by the IHS as an enrolled member of a federally recognized tribe living on or near a tribal land who used an IHS-funded service at least once either in the year reported or in the 2 years prior. All user records (average of 42,153 per year) had SSN verified by the IHS, whereas 93% of hospital discharge records had SSN. Hospitalizations of newborns and infants were excluded because 65% had missing SSN.

Data for characteristics of the TOHP and their service areas came from the IHS,¹⁰ and data for Indian gaming revenues came from state Indian Gaming reports.^{25,26} Community context characteristics for AIAN and whites came from Census 2000 Summary Data Files for AIAN and whites.

Health Outcome

The outcome indicator was the HASC rate for Active Users of a TOHP adjusted for age and gender of the individuals hospitalized.²⁷ The conditions included were: angina, asthma, bacterial pneumonia, bronchitis, cellulitis, congenital syphilis, congestive heart failure, COPD, dehydration, dental

conditions, diabetes, gastroenteritis, grand mal seizure disorders, hypertension, hypoglycemia, immunization preventable conditions (ages 1–5), iron deficiency anemia (ages 1–5), kidney and urinary tract infection, nutritional deficiency, pelvic inflammatory disease, ruptured appendix, severe infection of the eyes, ears, nose and throat, and tuberculosis.

IHS Funding

The indicator for IHS funding of TOHP was the Federal Disparity Index (FDI). The index is the percent of personal medical costs per user of an IHS service unit (such as TOHP) relative to a benchmark amount for medical costs of a standard package of benefits for a specified category of federal employees.⁵ Differences between the benchmark benefits and those of the IHS funded care in the index were minimized by actuaries who developed the index. There were a number of nonfunding component factors in the index that varied with TOHP and could therefore potentially confound a funding effect of the index in this study. In preliminary testing however, only the Medical Price Index for the service areas of the TOHP was found to have a significant independent effect on the outcome, and so only the Medical Price Index was retained for adjusting final models testing the funding effect of just the FDI.

Supply of TOHP Ambulatory Care

For the volume of the eligible population served, we used the TOHP Active User population from the IHS Final User Population Estimates for 2001. For indicators of the amount of care provided, we isolated the amount of IHS Clinic Funds allocated to TOHP clinics to provide primary care and the Contract Health Care Funds allocated to purchase specialty care. Because the IHS funds allocated depend on the volume of TOHP users, we also tested indicators for Clinic Funds per User and Contract Health Care Funds per User. For quality of care, Government Performance Reporting Act (GPRA) Indicators for 2002 in 3 areas of care were included: diabetes (H_gA1C in recommended range, blood pressure in recommended range, lipids measured, kidney function assessed, retinopathy tested); women's cancer prevention (pap smear and mammogram); and infectious disease prevention (influenza and pneumococcal immunizations in elders) and a combined mean of the 3 performance indicators.

Demand for TOHP Ambulatory Care

Indicators for the volume of eligible AIAN served by the TOHP included the Service Population and User Penetration Rate. The Service Population for each TOHP is estimated using Census data by the IHS Program Statistics agency.²⁸ The User Penetration Rate was calculated by dividing the number of TOHP Active Users by the Service Population for 2002.

The community context indicators of AIAN socioeconomic status and resources for seeking care were compiled from census data for "AIAN only" in the census tracts of the communities served by each TOHP. Per capita and median household income are expected to increase with socioeconomic status and be associated with lower rates of avoidable outcomes. The indicators available for low AIAN socioeco-

omic status in the TOHP service areas and expected to be associated with higher rates of avoidable outcomes included percent of AIAN with no high school diploma, AIAN households with incomes below federal poverty level, and AIAN unemployed. In addition, there were 3 indicators likely to reduce the ability of AIAN to get ambulatory care and increase ambulatory care-sensitive health outcomes: AIAN households with no vehicle available, AIAN households without telephone service, and AIAN households with more than 1 occupant per room on average. Disparities between AIAN and non-Hispanic whites for the community context indicators were determined by subtracting the indicator value for AIAN from the indicator value for non-Hispanic whites living in the same census tracts.

Indian gaming revenues potentially contribute to the income of tribal members and their communities and would be expected to have effects like the community context indicators for per capita and household income. The relative amounts of gaming revenues for the tribes sanctioning each TOHP were estimated by combining the State Indian Gaming Fund Contributions that the Gambling Control Commission received between May 1, 2001 and September 30, 2002 from each gaming tribe in each TOHP tribal consortium.^{25,26} We tested the following indicators: total amount, amount per AIAN in the service population, and amount per AIAN user. The amounts paid were not audited, and there were various methodologies used by tribes to calculate the contributions.²⁵ We therefore also obtained data on the numbers of gaming devices from the websites of each tribe or their casino in 2006 and tested the following indicators for the number of slot devices: total number, number per AIAN in the service population, and number per AIAN user.

Analysis

Associations of the funding, supply, and demand indicators with the outcome were tested using Generalized Estimating Equation models that take into account correlated errors with clustering (GENMOD in SAS).²⁹ The strengths of the associations were measured by the rate ratios of the outcome. The statistical significance of the associations was determined with Wald statistics. Each indicator within an indicator group was tested in a separate model to avoid problems of intercorrelation.

The main effect of the funding index on the outcome was first tested for all 23 TOHP, but the study sample had to be restricted to the 20 TOHP with FDI less than 60%. The sample was restricted because there was a linear relationship between the funding index and outcome for the TOHP with FDI less than 60% but not for those with indices greater than 60%. Because there were only 3 TOHP with FDI greater than 60%, we could not determine whether there was a different effect in this region or no effect at all. Therefore TOHP with FDI greater than 60% were excluded from further analysis. For the 20 TOHP in the final sample used in analysis, there were 3168 HASC.

Each demand characteristic was tested for confounding effects on the association between FDI and the outcome. Each potentially confounding indicator with a significant association with the outcome in model 1 was selected to test

whether it actually confounded the funding effect by reducing the size or significance of the FDI rate ratio while retaining its own significant independent rate ratio with the outcome in model 2. Confounders were retained for adjusted main effect models that also included the Medical Price Index (model 3). A criterion of significance of $P \leq 0.10$ was used to retain variables to avoid prematurely eliminating indicators that might become significant at $P \leq 0.05$ in later models.

To test whether supply characteristics mediated the association of the FDI with the outcome, first the rate ratio of each supply indicator with the outcome was determined by itself in model 4, and then each indicator was tested for a mediating effect in model 5 adjusted for confounders that met the criteria for confounding in model 3. The criteria for a mediating effect included: (1) a significant independent association of the supply indicator with the outcome (supply rate ratio, model 4); (2) a reduction of the size and significance of the association of the funding indicator adjusted for confounding (FDI rate ratios, model 3 compared with model 5); and (3) a retention of the significance of the supply indicator with the outcome (supply rate ratios, model 4 compared with model 5).

RESULTS

For characteristics to have detectable effects on the outcomes, their indicators need to vary across TOHP (Tables 1 and 2). The coefficient of variation for the HASC rate

TABLE 1. Variation in Characteristics of TOHP Funding, Supply, and Outcome of Ambulatory Care

Characteristics of TOHP Funding, Supply, and Outcome of Care	Mean	SD	Coefficient Variation*
IHS funding			
Federal Disparity Index (FDI)	44.4%	8.2%	18.5%
Medical Price Index used in FDI	1.05	0.06	5.7%
Supply of ambulatory care			
Volume of eligibles served			
AIAN user population	2553	1558	610%
Amount of care funded			
Primary care funds	1,573,577	960,269	61.0%
Specialty care funds	761,962	426,088	55.9%
Primary care funds per user	591	119	20.2%
Specialty care funds per user	293	55	18.8%
Quality of care			
Diabetes care performance	47%	6%	13.5%
Women's cancer screening care	44%	13%	28.7%
Infectious disease prevention	46%	18%	38.8%
Combined mean of the above	46%	8%	16.9%
Health outcome (adjusted for age and gender)			
Rate of hospitalizations for ambulatory-care sensitive conditions	188	44	23.4%

*Coefficient of variation is the SD divided by the mean.

adjusted for age and gender is 23.4% and for the FDI is 18.5% (Table 1). All other indicators tested have greater variation than these variables except certain ambulatory care characteristics (Tables 1 and 2). The diabetes performance indicator had a variation of 13.5% and the combined performance indicator for diabetes, cancer, and infectious disease had a variation of 16.9% (Table 1). Because there is less variation in these performance indicators than in the FDI, which is the main variable tested in the study hypothesis, it is possible that ambulatory care performance may have effects that are not detected in the models that successfully detect an effect of the funding index.

IHS Funding Effects

There was a significant association of IHS funding with HASC outcomes for TOHP with FDI less than 60%. The HASC rate dropped 12% for every 10% increase in the FDI (Table 3; model 2; $P = 0.011$). The Medical Price Index met the study criterion of a confounder (Table 3; model 2, rate ratio 0.90; $P = 0.024$) and was included in models testing confounding effects of demand characteristics (model 3) and mediating effects of ambulatory care characteristics (model 5).

Confounding Effects of Demand Characteristics

Demand characteristics of the AIAN eligible population in the TOHP service areas were not found to confound the IHS funding effect. Though the user penetration rate had a significant association with the outcome (Table 3; model 1; $P = 0.10$), the size of the association of the FDI was reduced only from 12% to 11%, and its significance increased when the penetration rate and funding index were included together in a model (Table 3; model 2; FDI rate ratio 0.89; $P = 0.008$).

Most of the community context characteristics likely to influence demand for TOHP had little if any confounding effect. Five of the 8 socioeconomic status and resource characteristics had significant independent associations with HASC rates: per capita income of AIAN, median household income of AIAN, and percent of AIAN households with incomes below poverty, percent of AIAN households without telephone service, and percent of AIAN households without a vehicle (Table 3; model 1). When each significant characteristic was tested in turn with the FDI for confounding; however, only the AIAN median income retained an independent effect ($P = 0.096$) and reduced the size and significance of the FDI effect at all (Table 3, model 2, rate ratio 0.90; $P = 0.027$). None of the Indian gaming characteristics had any significant effect on HASC rates (Table 3, model 1).

Even when expressed as disparities, the community context characteristics likely to influence demand for TOHP had little consistency in confounding effects. We tested whether the disparities between AIAN and whites in socioeconomic and resource characteristics had significant effects on the outcome because the indicators for AIAN alone had effects in the opposite direction of those expected: higher socioeconomic status and resources were associated with

TABLE 2. Variation in Characteristics of Demand for TOHP Ambulatory Care in the TOHP Service Areas

Characteristics of Demand for Care in TOHP Service Areas	Mean	SD	Coefficient Variation*
Eligible population			
Service population	5206	4397	84.5%
User penetration rate	63%	27%	43.1%
Community context			
Socioeconomic status and resources			
Pct of AIAN with no high school diploma	30%	7%	21.4%
Average income per AIAN	\$12,759	\$3421	26.8%
AIAN median household income	\$30,831	\$7761	25.2%
Pct of AIAN households below federal poverty level	27%	7%	26.0%
Pct of unemployed AIAN	9%	3%	32.5%
Pct of AIAN households with no vehicle available	13%	4%	33.8%
Pct of AIAN households without telephone service	8%	6%	80.0%
Pct of AIAN households with >1 person per room	13%	5%	36.7%
Disparities between AIAN and whites			
Difference in pcts with no high school diploma	17%	6%	34.7%
Difference in average income per person	-\$8758	\$3276	37.4%
Difference in median household income	-\$8439	\$5546	65.7%
Difference in pcts of households below poverty level	20%	14%	71.8%
Difference in pcts unemployed	5%	2%	50.8%
Difference in pcts of households with no vehicle	7%	4%	61.5%
Difference in pcts of households without telephone	5%	4%	71.0%
Difference in pcts of households >1 person per room	10%	5%	48.5%
Indian gaming revenues			
Gaming fund contributions by TOHP gaming tribes	\$5,590,117	\$3,162,079	56.6%
Fund contributions per AIAN in service population	\$660	\$475	72.0%
Gaming fund contributions per TOHP user	\$2202	\$1326	60.2%
Indian gaming slot devices	13,042	6578	50.4%
Slot devices per AIAN in TOHP service population	3.6	1.5	41.9%
No. slot devices per TOHP user	7.1	3.3	45.7%

*Coefficient of variation is the SD divided by the mean.

poorer, not better, outcomes (Table 3, model 1). The findings for disparities were similar, however. Three indicators had significant independent associations with HASC rates (disparity in percents unemployed, without a vehicle, or without telephone service), and for every 10% increase in the disparity, there was a significant decrease of 24% to 31% in the HASC rate (Table 3, model 1). When each significant indicator was tested in turn with the FDI, only the disparity in households without vehicles retained a significant effect ($P = 0.010$) and reduced the FDI effect in both size (2%) and significance (from $P = 0.011$ to $P = 0.014$) (Table 3, model 2). The other 2 disparities were still considered potential confounders. The significant effect of the disparity in unem-

ployment rates was so large that for every 10% increase in the disparity the HASC rate increased 45%, and the significance of the FDI effect was reduced from $P = 0.011$ to 0.029. The disparity in lack of telephone service reduced the significance of the FDI effect substantially from $P = 0.011$ to 0.074. Therefore all 3 disparities were included in separate models testing the IHS funding effect after adjustment for confounding (Table 4).

The main effect of IHS funding with HASC rates remained robust after adjusting for each confounding demand characteristic. The funding effect remained a 9% to 11% decrease in the HASC rate for every 10% increase in the FDI when each confounding community context characteristic

TABLE 3. Selection of Potentially Confounding Demand Characteristics With Significant Independent Measures of Association With the HASC Rate Outcome (Demand Rate Ratio, Model 1) and the Test of Confounding for Each Selected Characteristic on the Size and Significance of the Independent Measure of Association of the IHS Funding Index With the Outcome (FDI Rate Ratio, Model 2)

Funding and Demand Characteristics	Model 1			Model 2					
	Demand Rate Ratio	95% CI	P	Demand Rate Ratio	95% CI	P	FDI Rate Ratio	95% CI	P
IHS funding									
Federal Disparity Index (FDI)	NA			NA			0.88	0.79–0.97	0.011 [†]
Medical Price Index used in FDI	NA			1.13	0.99–1.30	0.08*	0.90	0.82–0.99	0.024 [†]
Eligible population									
Service population	1.01	0.99–1.02	0.26	NA					
User penetration rate	0.97	0.94–1.00	0.10*	0.98	0.96–1.01	0.198	0.89	0.82–0.97	0.008 [†]
Community context									
Socioeconomic status and resources									
Pct of AIAN with no high school diploma	0.98	0.87–1.10	0.77	NA					
Average income per AIAN in \$1000	1.03	1.00–1.06	0.10*	1.02	0.99–1.05	0.15	0.89	0.81–0.98	0.018 [†]
Median AIAN household income in \$1000	1.01	1.00–1.02	0.02 [†]	1.01	1.00–1.02	0.096*	0.90	0.81–0.99	0.027 [†]
Pct of AIAN households below federal poverty level	0.92	0.82–1.02	0.10*	NA					
Pct of unemployed AIAN	0.82	0.64–1.05	0.12	NA					
Pct of AIAN households with no vehicle available	0.76	0.59–0.98	0.03 [†]	0.80	0.65–0.98	0.03 [†]	0.89	0.82–0.97	0.008 [†]
Pct of AIAN households without telephone service	0.88	0.76–1.02	0.10*	0.96	0.85–1.09	0.53	0.89	0.80–0.99	0.027 [†]
Pct of AIAN households with >1 person per room	1.12	0.91–1.37	0.29	NA					
Disparities between AIAN and whites									
Difference in pcts with no high school diploma	0.99	0.85–1.16	0.94	NA					
Difference in average income per person	1.00	0.98–1.03	0.84	NA					
Difference in median household income	1.01	0.99–1.03	0.34	NA					
Difference in pcts of households below poverty	1.02	0.96–1.09	0.51	NA					
Difference in pcts unemployed	0.79	0.59–1.04	0.09*	0.75	0.55–1.03	0.07*	0.87	0.80–0.96	0.029 [†]
Difference in pcts of households with no vehicle	0.74	0.59–0.93	0.01 [†]	0.79	0.65–0.95	0.01 [†]	0.90	0.83–0.98	0.014 [†]
Difference in pcts of households without telephone	0.77	0.60–1.00	0.05*	0.92	0.67–1.25	0.58	0.90	0.80–1.01	0.074*
Difference in pcts of households >1 person per room	1.08	0.90–1.31	0.40	NA					
Indian gaming revenues									
Gaming fund contributions by TOHP gaming tribes	1.00	1.00–1.01	0.31	NA					
Fund contributions per AIAN in service population	1.37	0.27–7.03	0.71	NA					
Gaming fund contributions per TOHP user	1.00	0.65–1.56	0.99	NA					
Slot devices for TOHP gaming tribes	1.00	1.00–1.00	0.66	NA					
Slot devices per AIAN in TOHP service population	1.12	0.12–10.52	0.92	NA					
No. slot devices per TOHP user	2.40	0.28–2.93	0.88	NA					

*P < 0.10.

†P < 0.05.

was adjusted (Table 4; model 3; P = 0.011–0.039). The AIAN median household income effect and the disparities in community context effects became insignificant in the full

model except for the disparity in households without vehicles, which had an effect reduced from 21% (Table 3; model 2; P = 0.01) to 18% (Table 4; model 3; P = 0.01). The

TABLE 4. Tests of the Main Hypothesized Association of the IHS Funding Index With the HASC Rate Outcome (FDI Rate Ratio) After Adjustment for Each Confounding Demand Characteristic Identified in Table 3 (Demand Rate Ratio) and Confounding Funding Characteristic (Medical Price Index Rate Ratio) (Model 3)

Confounding Demand Characteristics	Model 3 [‡]								
	Demand Rate Ratio	95% CI	P	Medical Price Index* Rate Ratio	95% CI	P	FDI Rate Ratio	95% CI	P
Median AIAN household income in \$1000	1.00	0.99–1.02	0.59	1.08	0.87–1.34	0.48	0.90	0.82–0.99	0.030 [†]
Difference in pct's unemployed	0.83	0.63–1.10	0.12	1.09	0.94–1.25	0.26	0.89	0.81–0.97	0.011 [†]
Difference in pct's of households with no vehicle	0.82	0.70–0.96	0.01 [†]	1.08	0.97–1.21	0.15	0.91	0.85–0.99	0.021 [†]
Difference in pct's of households without telephone	1.01	0.76–1.34	0.97	1.13	0.98–1.31	0.09*	0.90	0.81–0.99	0.039 [†]

*P < 0.10.

†P < 0.05.

‡The Medical Price Index used in the FDI passed the test for confounding in model 2 and is therefore included with each test of a demand characteristic.

TABLE 5. Potentially Mediating Characteristics of Ambulatory Care Tested for Their Independent Association With the HASC Outcome (Supply Rate Ratio, Model 4) and for Mediation Reducing the Size and Significance of the Association of the IHS Funding With the Outcome (FDI Rate Ratio) After Adjustments for Each of the Confounding Characteristics Retained After Tests of Confounding in Table 4[‡] (Model 5)

Supply of Ambulatory Care Characteristics	Model 4			Model 5 [‡]					
	Supply Rate Ratio	95% CI	P	Supply Rate Ratio	95% CI	P	FDI Rate Ratio	95% CI	P
Volume of eligibles served									
AIAN user population	1.00	0.99–1.06	0.19	1.01	0.98–1.04	0.56	0.91	0.83–0.99	0.024 [†]
Amount of care funded									
Primary care funds	1.00	1.00–1.00	0.35	1.00	1.00–1.00	0.32	0.90	0.83–0.98	0.012 [†]
Specialty care funds	1.00	1.00–1.00	0.29	1.00	1.00–1.00	0.31	0.90	0.83–0.98	0.023 [†]
Primary care funds per user	0.76	0.43–1.35	0.34	1.30	0.50–3.37	0.59	0.87	0.76–1.01	0.075*
Specialty care funds per user	0.58	0.22–1.57	0.28	1.85	0.59–5.82	0.29	0.88	0.81–0.97	0.007 [†]
Quality of care									
Diabetes care performance	1.04	0.93–1.18	0.47	0.97	0.88–1.07	0.58	0.91	0.84–0.98	0.019 [†]
Women's cancer screening care	1.03	0.96–1.10	0.40	0.98	0.93–1.03	0.37	0.90	0.82–0.98	0.012 [†]
Infectious disease prevention	1.02	0.98–1.07	0.28	0.99	0.95–1.03	0.68	0.90	0.82–0.98	0.019 [†]
Combined mean of the above	1.07	0.95–1.21	0.25	0.96	0.88–1.05	0.40	0.90	0.82–0.98	0.012 [†]

*P < 0.10.

†P < 0.05.

‡Medical Price Index and the disparity in AIAN and white households without a vehicle are included.

disparity in households without vehicles and the Medical Price Index were retained as confounding factors that needed to be adjusted in models testing the mediating effects of supply characteristics of ambulatory care.

Mediating Effects of Ambulatory Care Supply Adjusted for Demand

We did not find evidence that any of the TOHP ambulatory care characteristics tested had mediating effects. They neither had significant independent associations with HASC outcomes (supply rate ratios; Table 5, model 4), nor did they reduce the size of significance of the

main effect of IHS funding with the outcome when added to models adjusted for confounding demand characteristics (FDI rate ratios, Table 5, model 5). Although the amount of IHS funds allocated for primary care did pass part of the test of mediation, the primary care indicator itself was not significantly associated with the outcome to begin with (model 4). Introduction of the primary care indicator to the model adjusted for confounding lowered the significance of the FDI rate ratio to a level below the criterion of inferential significance (from $P = 0.021$ in Table 4 model 3 to $P = 0.070$ in Table 5 model 5), and the supply rate ratio retained the size of its association and its P value

(from 1.00, $P = 0.34$ in Table 5 model 4 to 1.00, $P = 0.32$ in Table 5 model 5), but the ambulatory care indicator was not significantly associated with the outcome.

DISCUSSION

The amount of IHS funding of medical care that TOHP received had a robust association with HASC outcomes for AIAN who use the TOHP. For TOHP with funding less than 60% of what the federal government pays for federal employee coverage, the hospitalization rate for ambulatory care sensitive conditions rose 12% for every 10% decrease in the difference between IHS and the benchmark coverage. The range of the IHS funding effect was reduced to a value of 9% to 11% when adjusted for confounding characteristics.

The study did not find characteristics of the TOHP ambulatory care that mediate the funding effects on the outcomes. The study found some evidence that the amount of funds allocated to TOHP for primary care reduced the significance of the funding effect on the outcome, but there are a number of reasons why the indicator used for primary care may not reduce the size of the FDI effect. Each TOHP has a degree of operational independence and flexibility in allocating funds, and none are required to spend precisely according to funding categories. What is needed are more direct indicators of primary care volume and type. Although the state of California collects such data for primary care clinics, not all TOHP on tribal lands report routinely. The IHS collects workload data of encounter type and volume from all of its service units for reporting to Congress, but this data was not available to us identified by TOHP. With the results of this study we will be able to justify obtaining such data for further analyses.

The ambulatory care performance indicators tested in the study are not likely to have demonstrated an effect on HASC because of the lack of a common dimension of the performance and outcome indicators. The conceptual work that led to the development of HASC indicator was not closely related to the search for indicators of quality of care.¹⁶ The IHS performance indicators were for preventive care of selected diagnoses: diabetes, cancer, and infectious disease. The HASC diagnoses included only 1 or 2 relatively rare complications of those conditions and did include complications of other diagnoses. We had expected that the overall performance indicator might have a crude correlation with the ambulatory care-sensitive outcome, but it does not reflect on the validity of the performance indicator or the outcome indicator that the 2 are not correlated. If the overall performance indicators included a broader range of conditions and services or the outcome indicator was focused on a narrower range of conditions, then a correlation between the performance and outcome indicators might develop.

Community context characteristics of higher socioeconomic status and greater resources among AIAN in the service area of the TOHP were associated with poorer, not better, outcomes. Both higher per capita and median household income of AIAN and lower percent of AIAN households without telephone service or without a vehicle in the service area were associated with higher HASC rates. It is possible

that these effects occur because in communities where there are wealthier AIAN, more AIAN may have health insurance that provides access to other providers besides the TOHP. The AIAN who then rely on the TOHP in these communities may be of lower socioeconomic status and at higher risk for poor outcomes. To explain the paradoxical community context effects would require information comparing users of the TOHP and other AIAN in the communities for their on socioeconomic status and health insurance, including Medicare and Medicaid, as well as on the availability of providers other than TOHP who accept the health insurance in these rural communities.

There are a number of limitations in the data and indicators available to remove potential confounders of the relationship between TOHP funding and HASC rates. The outcome itself has inherent limitations as an indicator sensitive to ambulatory care: severity of disease, socioeconomic factors, and environmental conditions can affect some diagnoses in ways that ambulatory care cannot prevent, and the demand indicators we tested cannot adjust. The database also does not include hospitalizations of military and veteran AIAN in the urban Veteran and military hospitals in the state, and therefore undercounts HASC in a way that might vary among TOHP depending on utilization of those hospitals. A major limitation is the lack of individual level data on patients' health status, access, or health-seeking behaviors, which have been shown to affect HASC in urban areas.^{13,24} Instead, we used community context indicators related to these dimensions that have been used by others in rural areas where individual level data was lacking.^{12,18,20,23} We also lacked information on the extent to which the TOHP users had public or private health care coverage other than IHS and therefore potential access to additional ambulatory care providers.^{20,30} In analyses not shown, we found that the lack of an expected third party payer for hospitalized TOHP users was not significantly associated with HASC rates, but a preferred adjustment would be the coverage of all TOHP users. We did not have provider-level data to adjust analyses for differences in hospital admission practices of clinicians in different areas of the state.³¹ In analyses not shown, we found that total hospitalizations per user and the total hospitalization rate per TOHP had significant effects on the outcome, but neither indicator affected the significance of the IHS funding effect and at most reduced the size to 8% rise in preventable hospitalization rate per 10% decline in the funding index.

Preventing unnecessary hospitalizations with comprehensive effective ambulatory care is important not only because they are costly in human and economic terms, but because they are an indicator that other health outcomes could potentially be improved with an increase in the access and effectiveness of health care. Additional funding of tribal health program care is likely to improve health outcomes of care for AIAN. The evidence provided in this study supports a change of IHS policy funding TOHP so that at least 60% of the health care costs of the AIAN who use tribal health programs are covered, instead of the current policy of 40%. The evidence in this study was presented in person to the federal Office of the Management and Budget in 2007, and

the IHS requested an increase in funding for TOHP in its 2008 budget citing the evidence from this study in their justification.

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