Contents lists available at ScienceDirect

Primary Care Diabetes

journal homepage: http://www.elsevier.com/locate/pcd

Original research

Primary care and survival among American Indian patients with diabetes in the Southwest United States: Evaluation of a cohort study at Gallup Indian Medical Center, 2009–2016

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ARTICLE INFO

Article history:
Received 9 August 2017
Received in revised form
6 November 2017
Accepted 18 November 2017
Available online 8 December 2017

Keywords:
Primary care
Diabetes
Navajo
American Indian
Health systems strengthening
STROBE
Access to care

ABSTRACT

Objectives: To evaluate the role of primary care healthcare delivery on survival for American Indian patients with diabetes in the southwest United States.
Methods: Data from patients with diabetes admitted to Gallup Indian Medical Center between 2009 and 2016 were analyzed using a log-rank test and Cox Proportional Hazards analyses.
Results: Of the 2661 patients included in analysis, 286 patients died during the study period. Having visited a primary care provider in the year prior to first admission of the study period was protective against all-cause mortality in unadjusted analysis (HR (95% CI) = 0.47 (0.31, 0.73)), and after adjustment. The log-rank test indicated there is a significant difference in overall survival by primary care engagement history prior to admission ($p < 0.001$). The median survival time for patients who had seen a primary care provider was 2322 days versus 2158 days for those who had not seen a primary care provider.
Conclusions: Compared with those who did not see a primary care provider in the year prior to admission, having seen a primary care provider was associated with improved survival after admission.

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https://doi.org/10.1016/j.pcd.2017.11.003

1. Introduction

The Indian Health Service (IHS) provides healthcare to approximately 2.2 million American Indians and Alaska Natives across the United States [1]. Part of care delivery by IHS includes primary care services, such as family medicine and internal medicine clinic visits, for eligible American Indian patients. Within the United States and abroad, primary care delivery has been shown to help reduce healthcare expenditures and improve patient-centered healthcare outcomes, including mortality [2–9].

In spite of this, a combination of funding and recruitment challenges contribute to a 25% vacancy rate for physicians and nurse practitioners within IHS, with an estimated annual rate of 47% of physicians planning to leave their IHS job in the next three years [10,11]. The healthcare provider shortage makes seeking a primary care provider (PCP) appointment difficult for patients, who in some IHS regions experience wait times of several months to see a PCP. In 2016, the Government Accountability Office published a report indicating that IHS should work to address long wait times for PCP appointments and provide standards of acceptability for wait times across the agency [12]. Though potentially helpful, challenges for IHS primary care delivery are not purely logistic; in 2015, the allotted expenditure per person by the United States Congress for patients treated by IHS was $3688 versus $9523 per person on average for other federally funded health programs [1]. Both funding and logistic challenges contribute to IHS's reduced capacity to provide adequate and timely primary care services.

In the face of these challenges, American Indian communities across the United States experience significant health disparities that may be improved with timely and comprehensive primary care delivery. One of twelve geographic regions served by IHS, Navajo Area Indian Health Services is located in the Four Corners region of the southwest (primarily New Mexico, Arizona, and Utah). The Navajo Nation comprises the majority of the population served by the IHS region, with a population of 332,000 people, though not all registered tribal members live on the reservation or seek care from IHS [13]. The Navajo Nation experiences a high prevalence of Type 2 Diabetes Mellitus (DM) with 25,000 tribal members living with diabetes and 75,000 who are prediabetic [14]. Despite these challenges, there is evidence that health disparities can be reduced and health outcomes improved through primary care access [15,16]. The objective of this paper was to evaluate the role of primary care healthcare delivery on survival for American Indian patients with diabetes in the southwest.

2. Methods

2.1. Study site

This analysis was completed by the research team at the Community Outreach and Patient Empowerment (COPE) Program in Gallup, New Mexico. COPE is a 501c3 non-profit organization and a sister organization of Partners in Health, a global healthcare organization that works primarily with community health workers to improve care delivery [17]. COPE began formally collaborating with the Navajo Nation in 2009. In 2013, Brigham and Women's Hospital received a Patient Centered Outcomes Research Institute (PCORI) contract to evaluate a project on a — Community Health Representative lead intervention with patients with chronic health conditions. The data for this project was abstracted for analysis for the PCORI study in six of the eight major health facilities comprising the Navajo Area IHS network.

COPE has two community advisory panels that guide the organization's mission and research plans. The Community Health Advisory Panel (CHAP) is comprised of patients with diabetes, their family members, and Community Health Representatives. The COPE Advisory Group (CAG) is comprised of Community Health Representative supervisors, physicians, nurses, hospital educators, IT personnel, and other healthcare workers who contribute to healthcare systems on the Navajo Nation. Both CHAP and CAG provide input on all research including study design, data interpretation, and generation of additional research ideas and recommendations based on research findings.

2.2. Study design and setting

This retrospective cohort study includes patients with diabetes admitted for any reason to Gallup Indian Medical Center (GIMC), an Indian Health Service facility in Gallup, New Mexico, between January 1st, 2009 and May 31st, 2016. GIMC is a health facility run by the IHS that primarily serves American Indian patients. GIMC has 99 inpatient beds and facilitates 250,000 outpatient and 5800 inpatient visits per year [18].

2.3. Data source

The RPMS system is an Electronic Health Record system that allows for the abstraction of clinical data at IHS facilities. Data for this project data was abstracted from the Resource and Patient Management System (RPMS) at Gallup Indian Medical Center, Northern Navajo Medical Center, Tsehootsooi Medical Center, Chinle Comprehensive Health Care Facility, Crownpoint Health Care Facility, and Kayenta Health Center during the summer of 2016. Patient data from Gallup Indian Medical Center was merged with other sites to include mortality events of the GIMC cohort that may have occurred elsewhere. All data were de-identified and the resulting database was used for study analysis.

2.4. Study participants

Participants had a diabetes mellitus diagnosis via ICD 9 coding (code 250) between 2009 and 2016 and were admitted at least once to GIMC during the same period. The first admission event after a diabetes diagnosis was used to evaluate covariates relevant to the study question. There were no age restrictions on cohort participation.

2.5. Variables

Covariates were originally selected based on literature review and input from co-authors. A list of covariates considered for inclusion was presented to COPE's CHAP and CAG members at

meetings in January 2017. Covariate lists were modified based on CHAP and CAG suggestions. Both panels identified additional covariates, such as family support and spirituality, that may contribute to survival, but that are not captured by clinical data at this time at GIMC.

The primary exposure variable was primary care engagement, defined by the CHAP and CAG. The definition for the primary covariate of interest was having at least one primary care visit to either a family medicine or internal medicine clinic in the year before the first hospital admission during the study period.

Binary and categorical covariates evaluated from the time of first admission included sex, documented history of substance use disorder, listing Gallup, New Mexico as the hometown, body mass index (BMI) at admission, and the presence or absence of a hemoglobin A1C (A1C) value in the patient's chart in the two years before admission. Continuous covariates evaluated from the time of first admission included age, length of stay of first admission, and distance in miles from the person's hometown to GIMC.

The primary outcome for this study was all-cause mortality.

2.6. Model building specifications

To avoid overfitting, we used a ten-to-one ratio of mortality events to degrees of freedom [19]. All models were fit to fall within the parameters of this ratio.

2.7. Quantitative variables

Patients with a documented history of alcohol use disorder or, separately, other substance use disorder per ICD 9 codes at the time of first admission were combined into a single covariate indicating substance use disorders. Age was categorized into ten-year age groups (1–10, 11–20, etc.). BMI, originally a continuous variable, was categorized as follows: underweight/normal (BMI <25), overweight (BMI ≥25 and <30), obese (BMI ≥30), and missing.

This project was approved by the Navajo Nation Human Research Review Board and Partners Healthcare Institutional Review Board.

2.8. Statistical methods

2.8.1. Primary analysis

Three Cox Proportional Hazards models were built to explore the relationship of having had a primary care visit in the year prior to first study admission on mortality. The first is a univariate model; the second also includes age and sex. The third includes age, sex, length of stay, history of substance use disorder, BMI category, home-site of Gallup, presence of an A1C value in chart, and distance in miles from the hometown to GIMC. A log-rank test was conducted to analyze overall differences in survival based on a history of primary care interaction in the year prior to admission.

2.8.2. Censoring and truncation

Data for this analysis was right censored using the last known contact time for patients during the study period. The data is also left truncated; however, deidentified data was used for this analysis and truncation was not adjusted for.

Of the covariates included in testing, we anticipated little potential missingness as only robust, complete variables were originally considered for inclusion in the study. A prespecified statistical analysis plan was created to use multiple imputation methods for variables missing greater than 10% of data. For all variables other than BMI, complete case analysis was used for covariates missing less than 10% of data. For missing BMI category data, a missingness indicator was included as a category. Patients without a mortality event were considered to still be living, and thus, no patients were dropped because of missing mortality information.

2.8.3. Primary analysis assumptions and model testing

Observations for this study are independent. Covariates were examined for multi-collinearity using a correlation coefficient of 0.80; covariates with a correlation coefficient of greater than 0.80 were considered to be collinear. Survival data was evaluated graphically and by using Schoenfeld residuals (using a p-value of 0.05) to verify proportional hazards.

2.8.4. Sensitivity analysis

Using the final adjusted Cox model, we identified influential points using Likelihood displacement values and removed observations with a displacement value greater than 0.1. Results from this model are reported alongside primary analysis results.

3. Results

3.1. Study participants

Among all patients with diabetes seen at GIMC between 2009 and 2016, 2680 had at least one admission event and were considered for model inclusion (Fig. 1). Of these, three patients were missing length of stay data and 14 were missing mileage data and were not included in the analysis. Two of the patients missing length of stay data had no other encounter with GIMC during the study period were also dropped from the analysis. Of the 2661 (99.3%) patients included in the cohort, 286 (10.7%) patients died during the study period and 232 patients (8.7%) had seen a primary care provider in the year prior to admission.

3.2. Main results

The unadjusted hazards-ratio indicates that patients who saw a primary care provider in the year prior to first study admission were less like to die versus those who did not see a primary care provider (HR (95% CI) = 0.47 (0.31, 0.73)). Adjustment for age and sex had similar results in model 2 (HR (95% CI) = 0.43 (0.28, 0.66)). None of the covariates were correlated ($p < 0.80$ for each relationship), and therefore all covariates were included in model 3, which again revealed a protective significant association between having seen a primary care provider before admission and mortality (HR (95% CI) = 0.47 (0.30, 0.74)). The proportional hazards assumption was verified

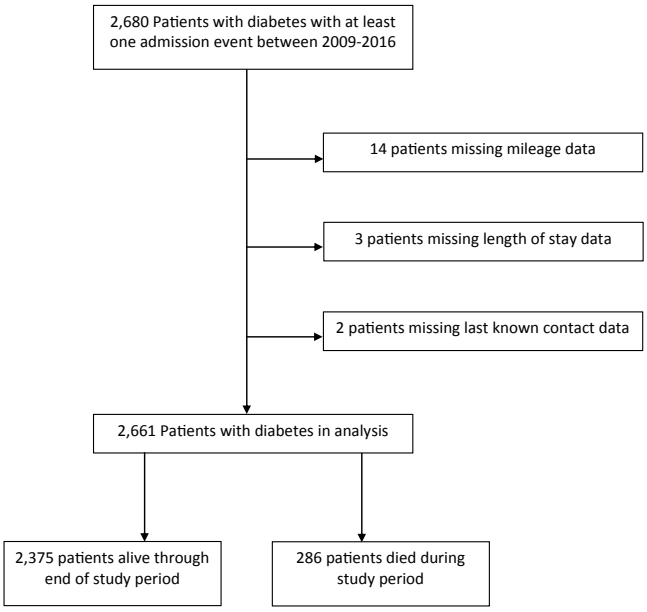

Fig. 1 – Participant flowchart for American Indian patients with diabetes at Gallup Indian Medical Center, 2009–2016.

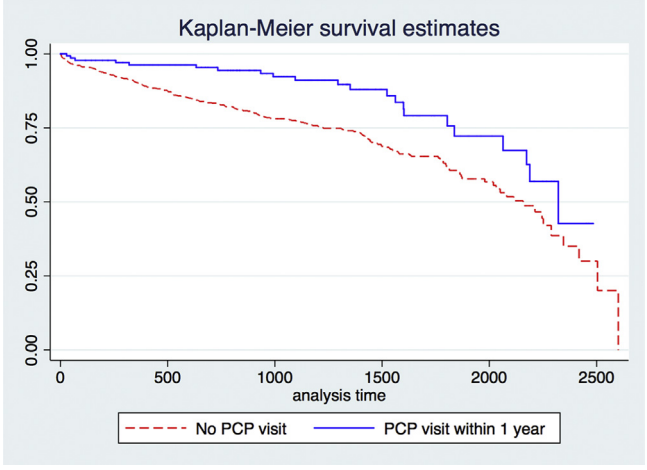

Fig. 2 – Kaplan–Meier survival curves by patient history of primary care provider visit in year prior to first study admission for American Indian patients with diabetes admitted to Gallup Indian Medical Center, 2009–2016.

graphically and by using the Schoenfeld residuals hypothesis test ($p > 0.05$).

The log-rank test indicated there is a significant difference in overall survival for those who saw a primary care provider in the year prior to admission versus those who did not ($p < 0.001$). The median survival time for patients who had seen a primary care provider was 2322 days versus 2158 days for those who had not seen a primary care provider (Fig. 2).

Additional risk factors for mortality identified in model 3 include older age, a normal or underweight BMI, and identifying Gallup, NM as the home service unit (all p values <0.05). Having an A1C in the two years prior to admission was protective against death ($p < 0.001$).

3.3. *Sensitivity analysis*

Influential points were identified using likelihood displacement values greater than 0.10 and removed during sensitivity analysis (n = 35). This model has less than 10% change in hazard ratio from model 3 and is reported in Table 1 (HR (95% CI) = 0.47 (0.30, 0.74)). The proportional hazards assumption was met for this model.

4. Discussion

This study sought to understand the effect of primary care engagement, defined by community members as having at least one visit to a primary care provider in the year prior to admission, on survival after a hospital admission for patients with diabetes. Compared to those who did not see a primary care provider in the year prior to admission, having seen a primary care provider was associated with improved survival after admission. This result was consistent across all three Cox proportional hazards models, the log-rank test, and in sensitivity analysis testing.

Only 9% of patients included in this study sought primary care appointments and accessed a provider in the year prior to their hospital admission; these patients may have benefited from primary care contact. Our study results are in accordance with previous research demonstrating that accessing primary care can improve survival and other health outcomes for different patient populations and disease groups, including cancer [2,7,9], mental health [8], DM [8,9] and others.

This study is unique in exploring the association between primary care and mortality for American Indian patients with diabetes. The hazard ratio estimate from our final model of 0.50 is larger than the value reported by Jerant et al. in their national evaluation of primary care and mortality [6] and smaller than the value reported by Copeland et al. in their evaluation of association between patients with diabetes who increase primary care usage and mortality [8]. Our study provides evidence that PCPs may have a stronger protective role against mortality for DM patients when compared to their protective role for the general population, but future research work should continue to explore the role of PCP care specifically for DM patients. Given the results of this study, future work should also consider contact with primary care providers post-discharge as a potential relevant factor on survival.

This study was strengthened by the stakeholder-driven research process. CHAP and CAG helped define the study question, the primary covariate, the study outcome, and the key covariates used in the analysis. Both panels also worked with the data analyst to interpret the clinical significance of study data and contributed to this publication.

This paper was limited by the use of a deidentified data set, which prohibited accounting for the left truncation of survival data. Additionally, conversations with both CHAP and CAG highlighted other covariates not captured by RPMS data. These include covariates such as socioeconomic status, family support at home after discharge, spirituality, employment status, access to a Community Health Representative, and others. Discussion with researchers also suggests that additional covariates including duration of DM, medication type and

Table 1 – Baseline characteristics of American Indian patients with diabetes admitted to Gallup Indian Medical Center between 2009 and 2016, n = 2680.

Characteristic	PCP visit within 1 year (n = 232)	No PCP visit within 1 year (n = 2448)
Age (years)	64.0 (10.8)	57.2 (16.9)
<10	0	1 (0.04)
10–19	0	15 (0.6)
20–29	1 (0.4)	124 (5.1)
30–39	5 (2.2)	277 (11.3)
40–49	14 (6.0)	449 (18.3)
50–59	59 (25.4)	501 (20.5)
60–69	82 (35.3)	457 (18.7)
70–79	58 (25.0)	390 (15.9)
80–89	13 (5.6)	200 (8.2)
90–99	0	33 (1.3)
>100	0	1 (0.04)
Sex (male)	92 (39.7)	1148 (46.9)
Length of stay (days) (n = 2677)	4.6 (6.0)	4.8 (5.6)
Substance use disorder	16 (6.9)	227 (9.3)
A1C in two years before admission	186 (80.1)	1722 (70.3)
Home service unit Gallup	231 (99.6)	2212 (90.4)
Miles from chapterhouse to hospital (n = 2666)	39.1 (76.8)	36.0 (58.1)
BMI normal	137 (59.1)	1452 (59.3)
Underweight	1 (0.4)	42 (1.7)
Overweight	65 (28.0)	579 (23.7)
No BMI recorded	29 (12.5)	375 (15.3)

adherence, and other factors could be useful in this research; however, we were unable to capture all covariates of interest in this study. Including these covariates could help identify other relevant factors in predicting survival after a hospital admission for patients with diabetes.

5. Public health implications

At the individual level, navigating the healthcare system with a primary care provider can still be challenging; navigating inpatient hospital care without external follow-up and continuity of primary care can be nearly impossible. In part because of this challenge, IHS began a program in 2008 called Improving Patient Care, the purpose of which is to improve care the quality of care among hospitals using Patient Centered Medical Home models. This model seeks to empanel patients within primary care in an effort to improve access to healthcare screenings and evidence-based care [20], but it has not yet reached all areas of IHS service delivery. While IPC expanded access to quality primary care services at some IHS facilities, and in spite of on-the-ground best efforts from hospital physicians and staff, systems-level barriers exist that prevent some sick patients from seeking and accessing primary care services in the southwest.

While patients face barriers including trust in healthcare delivery and travel logistics that may decrease their likelihood of seeking care, from the systems level perspective, challenges to improving primary care appointments are rooted in part from funding for IHS and retention of physicians and nurse practitioners, as well as an overall lack of investment in healthcare delivery for American Indian patients versus other US citizens. Proposals from the current administration related to long-term funding for IHS is concerning, particularly as early draft budgets cut IHS funding by 10.9%, or by 5.8 billion dollars, over the next ten years [21,22]. As the IHS works to provide critically needed healthcare services for American Indian populations, funding cuts will continue to exacerbate health disparities within American Indian communities [23].

6. Conclusions

This paper provides support for an association between primary care engagement and survival among American Indian patients with diabetes in the southwest United States. Future healthcare policy and clinical guidelines should seek to ensure primary care services are available and accessible for American Indian patients with diabetes. While many factors may impact the ability of patients to access primary care services, supporting policy and funding recommendations to increase access to primary care appointments could help address the physician shortage on reservations.

Funding

This work was supported by the Patient-Centered Outcomes Research Institute (PCORI) (AD1304-6566).

Conflict of interest

Dr. Shin is employed at Brigham and Women's Hospital and serves as PI for the PCORI contract. She is also the Executive Director of an affiliated 501(c)3 called Community Outreach and Patient Empowerment Program, Inc. which she serves in a volunteer capacity. The remaining authors state that they have no conflict of interest.

Acknowledgements

We would like to thank the COPE Project, CHAP (the Community Health Advisory Panel) and CAG (the COPE Advisory Group) for supporting this work and for their input throughout the entire study.

The opinions expressed in this paper are those of the author(s) and do not necessarily reflect the views of the Indian Health Service, the Patient-Centered Outcomes Research Institute, the Patient-Centered Outcomes Research Institute Board of Governors or the Patient-centered Outcomes Research Institute Methodology Committee.

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