

Research Article

Adherence to Standards of Practice Treating Diabetes between Physicians and Nurse Practitioners: The National Hospital and Ambulatory Medical Care Surveys

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ABSTRACT

Background: Much of the evidence of adherence to mutually agreed-upon rules for the treatment of diabetes among physicians and nurse practitioners comes from single clinics or registries, which leaves open the question as to whether these findings are nationally representative of current practice.

Aim: To evaluate standards of practice for treatment of diabetes among physicians and nurse practitioners across the United States.

Design: Observational study design using large, publicly available datasets.

Methods: We used data from the 2009-2011 National Hospital and Ambulatory Medical Care Surveys NAMCS, NHAMCS). We assessed standards of practice (HbA1c, foot exams, retinal exams) and delivery of patient education, using the checkbox for diabetes to identify all patients. We then examined differences in treatment using multivariate logistic regression models.

Results/findings: A total sample of 10,551 ambulatory and 11,546 outpatient department (OPD) records were analyzed (unweighted counts). Patient characteristics associated with provider adherence in both settings were identified by pairwise analysis. After adjustment and assigning survey weights, care was similar between both providers in ambulatory settings. Odds of receiving HbA1c were 2.47 times higher among nurse practitioners in OPD after adjustment. Across both surveys, nurse practitioners had lower odds of providing certain forms of patient education and counseling, including diet/nutrition, health education and 'other' education ($p<0.05$).

Conclusion: Using nationally representative databases for ambulatory and OPD visits, we found that physicians were more likely to deliver patient-based education and counseling, but were similar compared to nurse practitioners or slightly lower in the odds of delivering mutually agreed-upon treatment of diabetes.

Keywords: Diabetes; Guideline adherence; Nurse practitioner; Health care surveys

How this fits in with quality in primary care?

Few population-based data are available on the quality of outpatient care provided by nurse practitioners and physicians in the US for treatment of diabetes mellitus.

What do we know?

Evidence that nurse practitioners and physicians adhere to agree upon standards of care for treatment of diabetes mellitus is mixed and often derived from single clinical settings. Nationally representative datasets, such as the National Hospital and Ambulatory Medical Care Surveys, can be used to assess the quality of practitioner involvement and outcomes of care for many illnesses and diseases.

What does the paper add?

Adherence to standards of care for treatment of diabetes mellitus is similar among nurse practitioners and physicians in ambulatory care settings. In outpatient emergency department settings, the odds of receiving HbA1c were 2.47 times higher among nurse practitioners, whereas receipt of diet/nutrition-related counselling was 0.50 times lower among these providers. In outpatient emergency departments, individuals with diabetes mellitus are not receiving identical treatment by nurse practitioners and physicians.

Background

It is projected that by 2025 demand for physician care will increase by 17% concurrently with a physician shortage of nearly 90,000 to 100,000 [1,2]. These shortages are expected to disproportionately affect poor, rural and minority patients, particularly those with chronic diseases [3]. Expanding the number of nurse practitioners (NP) has been proposed as one possible solution to meet the increased demand for care while also controlling for healthcare costs [4-7]. Such expansions could reduce the effect of physician shortage by up to 65% [3].

One impediment to expanding the number of NPs are the limitations set by state scope of practice regulations [3]. Limitations in scope of practice for NPs have been in place as a safety measure with such limitations being supported by the medical community [8]. In 39 states nurse practitioners must practice under a physician practice or with a collaborative agreement with a physician [9]. Such restrictions and limitations on practice restrict delivery of mid-level care due to the requirement of collaboration creating the need to be in close proximity of a physician [3]. For example, treatment of many chronic conditions, such as diabetes, potentially would be more appropriately managed with decreased hospitalizations by increasing access of care by lifting scope of practice restrictions on NPs [8,10].

The American Diabetes Association (ADA) has set forth guidelines for the standard of care for diabetic patients. According to the ADA every diabetic patient should receive a comprehensive medical examination. The comprehensive medical exam should include a medical history, height, weight, BMI, foot examination and HbA1c test (if not performed in the past three months). The ADA also recommends all patients receive education on self-management [11], which should include nutrition and exercise education [12]. These guidelines for standards of care are in place to help better manage glycemic control. Increased glycemic control has been found to decrease complications from diabetes [13]. These guidelines are periodically updated and made available to providers to provide accepted standards of care in management of patients with diabetes.

Some studies have compared adherence to the standard of care practices for patients with a diagnosis of diabetes between NPs and physicians [14-18]. However, evidence thus far that NP providers improve upon or provide similar care compared to physicians has been inconsistent. For example, Condosta [14] found that NPs performed foot inspections, podiatry referrals and ophthalmology referrals more frequently than physicians, but hemoglobin A1C goal attainment was similar compared to physicians. It was found that NPs more frequently documented general diabetes education, nutrition education, exercise/weight education and hemoglobin A1C values than their MD counterparts did, but not with respect to foot exams or referrals to ophthalmologists. Kuo et al. [17] found that NPs and physicians tested for LDL at similar rates, but NPs performed eye examinations and hemoglobin A1C testing less frequently. Conlon found that NPs lowered HbA1c and glucose levels more effectively than physicians and also provided education at a higher level. While many studies provide variance among providers adherence to standards of practice, NPs have been found to demonstrate stricter adherence to standards of care for patients with diabetes [15,18].

Variations in findings may be due in part to small study samples or the lack of characterization of treatment patterns among different patient groups. Healthcare providers seeking to describe and act upon these findings also require diverse and population-wide representative samples from which to evaluate care practices. Databases such as the National Ambulatory Medical Care Survey (NAMCS) and National Hospital Ambulatory Medical Care Survey (NHAMCS), offer the opportunity to explore whether adherence to practice patterns is evident nationally. For example, the NAMCS captures a representative sample of all patients using ambulatory services of non-federally funded physician offices whereas the NHAMCS captures a representative sample of all patients in emergency and outpatient departments. Investigating practice patterns at this scope may provide more definitive evidence of current similarities or differences in the delivery of care and health education to patients among NP's and physicians.

Aim

The aim of this study was to report national estimates of adherence to accepted standards of care for adult patients with a diagnosis of diabetes when treated by physicians and NPs working in ambulatory and outpatient settings. Our evaluation sought to answer three questions. First, do NPs treat the same type of patients as their physician counterparts? Second, do NPs provide the same diagnostic tests and recommended screenings for patients with a diagnosis of diabetes compared to their physician counterparts? Third, do NPs provide the same education and counseling to patients diagnosed with diabetes as their physician counterparts?

Study Design

We analyzed data from 2009 to 2011 ambulatory and outpatient sections of the NAMCS and NHAMCS. Both are national surveys designed to provide annual information about the provision and use of medical care services in the office-based physician practices, with respect to the NAMCS, and about patient visits to hospital outpatient (OPD) and emergency departments, with respect to the NHAMCS.

Both the NAMCS and NHAMCS are cross-sectional probability samples derived from recruiting physicians and non-physicians to complete patient data and medical service forms for a representative sample of patient visits. Sampling is conducted using a multi-stage stratified probability approach and visit weights and clustering variables are used to derive nationally representative annual estimates of all ambulatory, OPD and emergency department visits in the United States, exclusive of federal, military, and veteran affairs facilities. Information about the sampling and design of the NAMCS and NHAMCS is publically available. This study only examines patient visits to ambulatory and OPD facilities.

Inclusion Criteria

Patient encounter records contained in years 2009 through 2011 for all ambulatory facilities were 32,281, 31,229 and 30,872, totaling 94,382 visits. Corresponding patient data for OPD facilities for years 2009 through 2011 were 33,551, 34,718 and 32,233, totaling 100,502 visits. We assumed that each encounter represented a different patient, although it is possible that multiple encounters could be representative of the same patient. However, we were unable to account for this possibility as there are no unique identifiers for patients in either publicly available database.

Inclusion criteria for patient encounter records included: (1) discharge alive, (2) ages 18 years and older, (3) a current diagnosis of diabetes as defined using the patient record form for the question "Does the patient have diabetes?" and (4) the primary provider defined as either a physician (MD) or nurse practitioner/mid-wife (NP), but not both. Our inclusion criteria captured 11.1 percent (n=10,551) of all the sampled ambulatory visits and 11.5 percent (n=11,546) of all sampled OPD visits between 2009 and 2011.

Study Variables and Variable Re-classification

Socio-demographic variables included: patient age, sex, race, ethnicity and insurance type. For patient race, the original classifications of 'Asian Only', 'Native Hawaiian/Other Pacific Islander Only', 'American Indian/Alaska Native Only' and 'more than one race reported' were collapsed into a single category, 'Other'. Patient insurance types were divided into the following categories: uninsured (includes self-pay), commercial indemnity (including worker's compensation), Medicare and Medicaid, and Other. Additional patient-level variables included body mass index (BMI), number of co-morbidities, diagnosis of obesity, current smoking status, previous visits, metropolitan status (MSA), as well as geographic region. BMI was calculated manually using the patient weight and height data columns as opposed to using the provider entered scores, thereby increasing the number of patient weight scores by 4.9 percent.

Statistical Analysis

Because the NAMCS and NHAMCS use complex survey sampling design, design effects were incorporated into the statistical analyses by using SAS software [ref]. Differences between means of continuous variables were examined using Student's t test, and differences in proportions of categorical variables were examined using the Rao-Scott F adjusted chi-square statistic. The weighted sample size was used to produce all 95 percent confidence intervals for all comparisons. Raw numbers from the survey are provided for clarity in reporting, particularly for instances having small counts.

We performed multiple logistic regressions to analyze differences in patient visits by provider type. Receipt of nine different care practices were analyzed: (1) HbA1c, (2) foot exam, (3) retinal exam, (4) health education ordered, (5) diet/nutrition education, (6) exercise education, (7) weight reduction, (8) other health education, and (9) referral to other physician. Variables identified from the pairwise comparisons with $p<0.25$ were included as potential factors that would affect the association between care provision and provider type.

Results

In the 2009 through 2011 NHAMCS and NAMCS datasets that met our inclusion and exclusion criteria, we identified 10,551 and 11,546 ambulatory and OPD visits (unweighted counts) that indicated diabetes using the checkbox. After appropriate weighting, the estimated number of visits by patients with diabetes in the United States was 355,536,392 (standard error [S.E.]: 20,234,631) in ambulatory care and 36,649,513 (S.E.: 3,299,345) in OPD setting. Nationally, these estimates represent 14.0% and 18.0% of all ambulatory and OPD visits in those years.

Univariate analyses

Socio-demographic and clinical characteristics of patients with diabetes seen by NPs and MDs as their primary care provider in ambulatory and outpatient care settings are shown in Table 1. In the ambulatory care setting, univariate analyses that were statistically significantly different ($p<0.05$) showed that NP's treated a larger proportion of male patients (63.0 vs. 52.6), older patients (66.4 vs. 62.9) as well as different composition of patients according to classifications of race. NP's also treated a different composition of patients according to the average number of visits over the previous 12 months (5.8 vs. 4.7) as well as BMI (33.1 vs. 32.5) and current smoking status (5.7 vs. 13.7). There were no statistically significant differences in patient demographics cared for by NPs and MDs when contrasted against insurance type, MSA designation and geographic region. Similarly, with the exception of the provision of 'other health education', there were no statistically significant differences in the type or frequency of care provided by NPs and MDs to patients having insulin dependent diabetes mellitus or noninsulin dependent diabetes mellitus.

In the outpatient care setting, NPs treated a larger proportion of male patients (64.8 vs. 58.4), younger patients (54.8 vs. 58.6) as well as different composition of patients according to classification of ethnicity. NP's also treated a different composition of patients according to BMI (35.1 vs. 33.1) and current smoking status (24.8 vs. 17.9). In contrast to ambulatory care setting, patient composition in the outpatient setting differed by insurance type and by non-MSA hospital status (31.4 vs. 14.3). With the exception of the frequency of referrals to other physicians (24.3 vs. 16.4), there were no statistically significant differences in the type or frequency of care provided by NPs and MDs with respect to diagnostic tests or patient education during care.

Unadjusted regression analyses

Table 2A shows unadjusted regression analysis for process of care for diabetes treatment among patients treated in ambulatory care. Of all care processes, only the odds of receipt of 'other' or unclassified patient education was statistically significantly different between NPs and MDs, with the odds 0.27 smaller that

Table 1: Characteristics of patients with Diabetes Mellitus according to whether they received ambulatory or emergency department care from nurse practitioners (NP) or physicians (MD), NAMCS and NHAMCS, years 2009-2011.

	NAMCS: Ambulatory Care (weighted)			NHAMCS: Outpatient Care (weighted)		
Characteristic	**NP (%, SEM)**	**MD (%, SEM)**	**p value**	**NP (%, SEM)**	**MD (%, SEM)**	**p value**
Predetermining factors						
Female	18 (27.0)	5,001 (47.4)	0.010	257 (35.2)	4,620 (41.6)	0.101
Age (SEM)	66.4 (3.0)	62.9 (0.3)	0.014	54.8 (1.4)	58.6 (0.5)	0.004
Race			<0.001			0.084
Caucasian	36 (63.1)	6,376 (60.9)		511 (71.6)	6,501 (58.7)	
African American	11 (31.1)	1,252 (12.1)		131 (5.7)	2,512 (25.5)	
Other	1 (0.0)	607 (4.6)		24 (6.8)	637 (4.5)	
Blank	4 (5.8)	2,264 (22.4)		68 (7.7)	1,162 (11.2)	
Ethnicity			0.063			0.001
Hispanic/Latino	12 (23.9)	1,250 (10.3)		82 (5.2)	1,729 (16.4)	
Non-Hispanic/Lation	37 (72.1)	7,148 (68.9)		595 (83.1)	7,660 (69.3)	
Blank	3 (4.0)	2,101 (20.8)		57 (7.8)	1,423 (14.3)	
Previous visits (SEM)	5.8 (1.0)	4.7 (0.1)	<0.001	5.4 (0.6)	5.2 (0.2)	0.685
BMI (SEM)	33.1 (1.1)	32.5 (0.1)	0.021	35.1 (0.7)	33.1 (0.2)	<0.001
Diagnosis of obesity	12 (26.7)	2,018 (19.9)	0.380	203 (26.6)	2,188 (19.8)	0.065
Comorbidities (SEM)	3.8 (0.2)	3.2 (0.0)	0.753	3.2 (0.2)	3.1 (0.1)	0.753
Current smokers	4 (5.7)	1,179 (13.7)	0.078	114 (24.8)	1,319 (17.9)	0.027
Enabling factors						
Insurance type			0.406			0.039
Private	13 (26.6)	3,632 (39.4)		222 (27.2)	2,382 (25.5)	
Medicare	24 (54.5)	4,799 (47.0)		242 (32.2)	4,408 (38.1)	
Medicaid	9 (10.0)	966 (6.9)		163 (22.8)	2,394 (18.9)	
Self-Pay	2 (0.7)	490 (2.5)		75 (15.0)	935 (9.5)	
Other	4 (8.2)	612 (4.2)		32 (2.8)	693 (8.0)	
Geographic region			0.957			0.772
Northeast	7 (23.3)	1,932 (17.8)		249 (30.6)	3,056 (31.6)	
Midwest	17 (24.1)	2,506 (21.2)		162 (27.3)	2,589 (25.7)	
South	12 (32.2)	3,356 (39.2)		236 (35.6)	3,394 (31.6)	
West	16 (20.3)	2,705 (21.7)		87 (6.5)	1,773 (11.1)	
Non-MSA	3 (13.8)	1,059 (12.3)	0.836	105 (31.1)	871 (14.3)	0.012
Need factors						
HbA1C	14 (37.2)	1,548 (19.4)	0.151	242 (33.7)	1,317 (20.1)	0.059
Foot exam	10 (17.0)	750 (8.5)	0.300	170 (15.2)	1,295 (12.0)	0.585
Retinal exam	2 (5.1)	396 (4.6)	0.923	107 (4.6)	358 (4.5)	0.988
Health education ordered	24 (43.5)	4,907 (49.7)	0.623	423 (61.0)	5,559 (51.5)	0.095
Diet/Nutrition education	18 (39.1)	2,067 (22.6)	0.162	180 (23.9)	2,051 (22.8)	0.817
Exercise education	13 (20.4)	1,328 (14.4)	0.539	107 (16.9)	1033 (13.2)	0.434
Weight reduction	6 (12.5)	869 (9.9)	0.649	53 (7.5)	571 (5.9)	0.612
Other health education	6 (8.9)	2,819 (26.7)	0.006	287 (40.8)	4,114 (33.8)	0.177
Refer to other physician	5 (7.7)	1,161 (10.6)	0.493	146 (24.3)	1,507 (16.4)	0.019

Source: NHAMCS and NAMCS data cycles, 2009-2011. All standard errors of the mean (SEM) correspond to weighted mean values

a patient would receive other forms of education among NPs (OR 0.27; 95% CI 0.10-0.75; p 0.012). Irrespective of provider, patient-level variations in process of care were observed most consistently in respect to BMI and patient race/ethnicity.

Table 2B shows unadjusted regression analysis for process of care for diabetes treatment among patients treated in OPD. In the unadjusted regression model, the odds of patient referral to another specialist were 1.91 times larger when seen by an NP compared to an MD (1.91; 1.52-2.39; p<0.0001). No other statistically significant differences by process of care type between NPs and MDs were observed. Irrespective of provider, the odds of care receipt were consistently larger among patients having a diagnosis of obesity with respect to Health Education, Diet/Nutrition Education, Exercise Education and Weight Reduction. Variation in care receipt also varied by patient insurance status, but not consistently by one form of indemnity payment.

Adjusted regression analyses

Table 3A shows adjusted regression analysis for process

Table 2A: Unadjusted differences in process of care between nurse practitioners (NP) and physicians (MD), NAMCS years 2009-2011.

	HbA1C		Foot exam		Retinal exam		Health Education		Diet/Nutrition Education		Exercise Education		Weight Reduction		Other Education		Referral	
Characteristic	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**
Provider																		
Phsician	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Nurse Practitioner	2.46 (0.69-8.76)	0.164	2.20 (0.48-10.19)	0.311	1.10 (0.15-7.94)	0.923	0.78 (0.29-2.13)	0.627	2.20 (0.71-6.83)	0.171	1.53 (0.40-5.88)	0.539	1.30 (0.42-3.97)	0.649	0.27 (0.10-0.75)	0.012	0.70 (0.26-1.94)	0.495
Female	1.39 (1.19-1.61)	<0.0001	1.29 (0.99-1.68)	0.057	1.14 (0.89-1.45)	0.298	1.04 (0.92-1.18)	0.513	1.12 (0.99-1.27)	0.068	1.22 (1.04-1.43)	0.013	1.00 (0.81-1.23)	0.973	0.95 (0.85-1.06)	0.364	1.04 (0.84-1.29)	0.737
Age	1.00 (0.99-1.01)	0.822	1.00 (0.99-1.01)	0.688	1.01 (1.00-1.02)	0.068	0.99 (0.99-0.99)	0.001	0.99 (0.98-0.99)	<0.0001	0.99 (0.98-0.99)	<0.0001	0.98 (0.98-0.99)	<0.0001	1.00 (1.00-1.01)	0.709	0.99 (0.99-1.00)	0.050
Race																		
Caucasian	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
African American	0.95 (0.70-1.27)	0.964	0.50 (0.32 - 0.77)	0.002	1.27 (0.86-1.88)	0.248	1.07 (0.77-1.48)	0.926	0.92 (0.64-1.33)	0.784	0.82 (0.55-1.20)	0.394	1.08 (0.68-1.70)	0.888	1.02 (0.76-1.36)	0.339	1.34 (1.04-1.73)	0.049
Other	1.20 (0.81-1.77)	0.108	1.67 (0.76-3.68)	0.060	0.80 (0.32-1.00)	0.555	1.56 (1.06-2.31)	0.015	1.21 (0.84-1.74)	0.121	1.15 (0.72-1.81)	0.291	1.24 (0.70-2.17)	0.453	1.56 (1.00-2.43)	0.061	1.02 (0.57-1.82)	0.833
Blank	0.72 (0.56-0.93)	0.006	0.90 (0.42-1.91)	0.901	0.97 (0.50-1.90)	0.916	0.82 (0.62-1.08)	0.1.6	0.76 (0.54-1.09)	0.131	0.84 (0.56-1.27)	0.529	0.90 (0.58-1.42)	0.432	1.03 (0.73-1.45)	0.457	0.94 (0.74-1.21)	0.295
Ethnicity																		
Hispanic/ Latino	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Non-Hispanic/ Lation	1.18 (0.84-1.65)	0.343	1.45 (0.78-2.67)	0.236	1.70 (0.91-3.12)	0.100	1.07 (0.80-1.43)	0.658	0.69 (0.47-1.02)	0.060	0.61 (0.39-0.96)	0.032	0.83 (0.51-1.35)	0.462	1.11 (0.74-1.65)	0.623	0.87 (0.65-1.17)	0.371
Previous visits	0.98 (0.95-1.00)	0.080	1.01 (0.98-1.04)	0.463	0.91 (0.86-0.96)	0.001	0.99 (0.98-1.01)	0.275	1.00 (0.97-1.02)	0.639	1.00 (0.98-1.02)	0.798	0.98 (0.96-1.01)	0.155	0.99 (0.97-1.01)	0.447	1.01 (0.99-1.03)	0.469
BMI	1.00 (0.99-1.01)	0.481	1.00 (0.99-1.02)	0.769	0.99 (0.96-1.02)	0.605	1.02 (1.01-1.03)	0.004	1.03 (1.02-1.04)	<0.0001	1.04 (1.03-1.06)	<0.0001	1.08 (1.07-1.10)	<0.0001	0.99 (0.98-0.99)	0.018	1.00 (0.98-1.02)	0.936
Current smokers	0.98 (0.75-1.26)	0.849	0.97 (0.70-1.34)	0.853	0.63 (0.41-0.98)	0.040	1.07 (0.89-1.29)	0.465	0.86 (0.69-1.07)	0.183	0.74 (0.55-0.99)	0.044	0.96 (0.70-1.31)	0.800	0.86 (0.68-1.09)	0.217	1.12 (0.84-1.50)	0.448

Table 2B: Unadjusted differences in process of care between nurse practitioners (NP) and physicians (MD), NHAMCS outpatient department (OPD) years 2009-

	HbA1C		Foot exam		Retinal exam		Health Education		Diet/Nutrition Education		Exercise Education		Weight Reduction		Other Education		Referral	
Characteristic	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
Provider																		
Physician	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Nurse Practitioner	2.02 (0.95-4.30)	0.068	1.31 (0.49-3.47)	0.587	1.01 (0.26-3.99)	0.988	1.47 (0.92-2.36)	0.108	1.06 (0.65-1.71)	0.818	1.34 (0.64-2.81)	0.443	1.28 (0.48-3.40)	0.615	1.35 (0.87-2.11)	0.186	1.91 (1.52-2.39)	<0.0001
Female	1.27 (0.94-1.70)	0.115	1.38 (0.98-1.94)	0.067	1.06 (0.69-1.64)	0.791	0.94 (0.79-1.11)	0.439	1.06 (0.84-1.34)	0.605	1.00 (0.74-1.36)	0.972	0.90 (0.66-1.23)	0.502	0.99 (0.81-1.22)	0.946	1.64 (1.07-2.51)	0.023
Age	1.00 (0.99-1.01)	0.590	1.00 (0.99-1.01)	0.824	0.99 (0.97-1.00)	0.124	0.99 (0.98-0.99)	0.000	0.98 (0.98-0.99)	0.001	0.99 (0.97-1.00)	0.081	0.98 (0.98-0.99)	<0.0001	xx (xx - xx)	0.000	1.01 (1.00-1.01)	0.186
Race																		
Caucasian	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
African American	0.85 (0.59-1.22)	0.762	0.79 (0.47-1.33)	0.661	0.90 (0.38-2.10)	0.946	0.68 (0.47-1.00)	0.199	0.68 (0.48-0.96)	0.680	0.51 (0.28-0.93)*	0.933	0.98 (0.61-1.58)	0.124	0.77 (0.53-1.02)*	0.038	1.28 (0.87-1.89)	0.374
Other	0.86 (0.42-1.76)	0.828	0.69 (0.33-1.47)	0.775	1.19 (0.61-2.32)	0.151	1.20 (0.69-2.07)	0.216	0.79 (0.44-1.41)	0.366	0.50 (0.30-0.84)*	0.972	0.65 (0.27-1.55)	0.710	1.78 (1.43-2.13)	0.001	1.39 (0.89-2.17)	0.195
Blank	0.61 (0.37-1.02)	0.128	0.55 (0.28-1.10)	0.178	0.57 (0.16-2.10)	0.245	0.48 (0.29-0.78)	0.002	0.33 (0.19-0.59)	0.001	0.25 (0.12-0.54)	0.000	0.44 (0.23-0.87)	0.045	0.67 (0.32-1.03)*	0.029	0.92 (0.61-1.37)	0.122
Ethnicity																		
Hispanic/ Latino	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Non-Hispanic/Latino	0.96 (0.62-1.49)	0.850	0.87 (0.3-1.78)	0.706	1.16 (0.49-2.74)	0.730	0.92 (0.62-1.37)	0.697	0.90 (0.61-1.33)	0.591	1.09 (0.57-2.10)	0.790	1.46 (0.83-2.57)	0.185	0.90 (0.52-1.57)	0.713	0.93 (0.63-1.38)	0.726
Insurance type																		
Private	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Medicare	0.94 (0.71-1.23)	0.295	1.04 (0.73-1.34)	0.796	0.92 (0.59-1.44)	0.114	0.86 (0.66-1.06)	0.147	0.76 (0.59-1.00)	0.234	0.64 (0.45-0.90)	0.922	0.89 (0.52-1.26)	0.544	0.89 (0.69-1.15)	0.777	1.09 (0.89-1.37)	0.989
Medicaid	0.61 (0.37-1.00)	0.115	1.51 (0.99-2.27)	0.987	1.54 (0.82-2.91)	0.352	1.03 (0.71-1.49)	0.080	1.08 (0.74-1.58)	0.145	1.48 (1.22-1.73)	0.003	0.89 (0.52-1.51)	0.051	1.00 (0.68-1.48)	0.200	1.22 (0.90-1.66)	0.286
Self-Pay	0.88 (0.58-1.34)	0.676	1.37 (0.71-2.66)	0.688	0.72 (0.32-1.65)	0.086	1.48 (1.22-1.73)	0.003	1.47 (1.00-2.14)	0.002	0.98 (0.51-1.88)	0.060	1.11 (0.66-1.88)	0.003	0.97 (0.59-1.58)	0.427	1.19 (0.81-1.75)	0.534
Other	0.77 (0.35-1.71)	0.809	2.27 (0.96-5.82)	0.163	2.54 (0.63-10.32)	0.153	0.47 (0.31-0.73)	0.001	0.47 (0.26-0.87)	0.005	0.20 (0.10-0.44)	<0.0001	0.17 (0.07-0.43)	<0.0001	0.53 (0.28-1.01)	0.034	0.97 (0.55-1.73)	0.604
Metropolitan Status																		
MSA	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Non-MSA	1.44 (0.65-3.17)	0.371	1.13 (0.38-3.37)	0.829	0.40 (0.11-1.49)	0.172	1.28 (0.37-4.40)	0.698	1.43 (0.54-3.83)	0.474	2.58 (0.67-10.0)	0.169	1.03 (0.41-2.60)	0.955	1.61 (0.44-5.83)	0.469	0.82 (0.41-1.67)	0.588
Diagnosis of obesity	1.26 (0.89-1.79)	0.194	1.79 (1.01-2.90)	0.019	1.73 (0.95-3.18)	0.075	1.68 (1.38-2.04)	<0.0001	2.04 (1.56-2.69)	<0.0001	2.20 (1.55-3.12)	<0.0001	8.14 (5.13-12.92)	<0.0001	1.11 (0.80-1.54)	0.540	0.95 (0.77-1.18)	0.667
Previous visits	0.98 (0.95-1.01)	0.122	0.98 (0.95-1.01)	0.241	0.92 (0.83-1.01)	0.079	1.01 (0.99-1.03)	0.285	0.99 (0.97-1.01)	0.350	0.97 (0.95-0.99)	0.027	0.93 (0.90-0.96)	<0.0001	1.02 (1.00-1.04)	0.052	1.00 (0.98-1.02)	0.846
BMI	0.99 (0.98-1.01)	0.310	1.00 (0.98-1.02)	0.693	0.98 (0.95-1.01)	0.166	1.02 (1.00-1.03)	0.035	1.03 (1.01-1.04)	0.006	1.03 (1.01-1.05)	0.001	1.09 (1.07-1.11)	<0.0001	1.00 (0.99 - 1.02)	0.792	1.01 (1.00-1.03)	0.118
Current smokers	0.84 (0.60-1.15)	0.275	0.71 (0.47-1.08)	0.110	0.76 (0.40-1.46)	0.412	1.22 (0.97-1.54)	0.097	0.83 (0.65-1.06)	0.129	0.93 (0.73-1.18)	0.529	0.80 (0.58-1.11)	0.184	0.83 (0.65-1.05)	0.114	1.12 (0.81-1.56)	0.470

Table 3A: Adjusted differences in process of care between nurse practitioners (NP) and physicians (MD), NAMCS years 2009-2011.

	HbA1C		Foot exam		Retinal exam		Health Education		Diet/Nutrition Education		Exercise Education		Weight Reduction		Other Education		Referral	
Characteristic	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
Provider																		
Physician	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Nurse Practitioner	0.24 (0.04-1.37)	0.109	4.00 (0.80-20.17)	0.093	2.28 (0.25-20.99)	0.466	0.27 (0.10-0.70)	0.007	0.43 (0.11-1.71)	0.231	0.60 (0.13-2.65)	0.500	1.05 (0.27-4.12)	0.948	0.18 (0.05-0.71)	0.014	0.06 (0.01-0.52)	0.101
Female	1.16 (0.93-1.45)	0.192	1.48 (1.05-2.09)	0.026	1.72 (1.11-2.66)	0.015	1.07 (0.87-1.31)	0.536	1.2 (0.99-1.52)	0.068	1.22 (0.96-1.55)	0.108	1.23 (0.93-1.64)	0.150	0.96 (0.76-1.22)	0.745	1.07 (0.74-1.54)	0.725
Age	1.00 (0.99-1.01)	0.575	1.0 (0.99-1.01)	0.960	0.99 (0.97-1.01)	0.183	1.00 (0.99-1.01)	0.946	1.00 (0.99-1.00)	0.203	0.99 (0.98-1.00)	0.042	1.00 (0.98-1.01)	0.446	1.00 (0.99-1.01)	0.925	1.00 (0.99-1.01)	0.788
Race																		
Caucasian	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
African American	0.89 (0.61-1.29)	0.820	0.56 (0.31-1.01)	0.758	0.73 (0.22-2.45)	0.620	1.06 (0.65-1.73)	0.937	1.18 (0.70-1.98)	0.271	0.94 (0.56-1.56)	0.496	1.20 (0.60-2.41)	0.941	0.88 (0.61-1.28)	0.230	1.38 (0.91-2.09)	0.037
Other	0.98 (0.61-1.57)	0.772	1.02 (0.41-2.58)	0.149	1.4 (0.51-4.07)	0.370	2.02 (1.31-3.12)	<0.0001	1.57 (0.94-2.62)	0.008	1.28 (0.74-2.20)	0.029	2.20 (1.25-3.86)	0.006	2.18 (1.31-3.61)	0.001	0.79 (0.26-2.37)	0.845
Blank	0.83 (0.47-1.48)	0.655	0.24 (0.10-0.56)	0.005	0.72 (0.26-2.01)	0.490	0.56 (0.33-0.95)	0.002	0.41 (0.25-0.68)	<0.0001	0.35 (0.18-0.68)	0.002	0.73 (0.34-1.57)	0.107	0.74 (0.36-1.53)	0.157	0.49 (0.21-1.14)	0.109
Ethnicity																		
Hispanic/ Latino	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Non-Hispanic/Latino	0.76 (0.47-1.23)	0.263	1.01 (0.44-2.33)	0.989	1.66 (0.64-4.30)	0.300	0.78 (0.52-1.18)	0.239	0.41 (0.26-0.66)	0.000	0.42 (0.26-0.66)	0.000	0.57 (0.26-1.25)	0.161	1.14 (0.72-1.83)	0.573	0.71 (0.36-1.43)	0.341
Previous visits	0.97 (0.93-1.01)	0.105	0.98 (0.94-1.03)	0.423	0.94 (0.83-1.07)	0.370	0.98 (0.96-1.01)	0.174	0.97 (0.94-1.01)	0.177	0.99 (0.95-1.02)	0.418	0.98 (0.94-1.02)	0.352	1.00 (0.97-1.04)	0.923	1.02 (0.97-1.07)	0.498
BMI	0.99 (0.97-1.00)	0.129	1.01 (0.99-1.03)	0.532	1.00 (0.96-1.03)	0.814	1.01 (1.00-1.03)	0.133	1.03 (1.02-1.05)	0.000	1.04 (1.02-1.06)	0.000	1.08 (1.07-1.10)	<0.0001	0.99 (0.97-1.00)	0.071	1.00 (0.98-1.02)	0.886
Current smokers	0.96 (0.69-1.34)	0.824	0.70 (0.46-1.08)	0.104	0.53 (0.24-1.15)	0.107	1.17 (0.88-1.56)	0.286	0.94 (0.69-1.29)	0.708	0.70 (0.46-1.08)	0.106	0.96 (0.65-1.42)	0.831	0.90 (0.64-1.27)	0.554	1.10 (0.72-1.69)	0.658

Table 3B: Adjusted differences in process of care between nurse practitioners (NP) and physicians (MD), NHAMCS outpatient department (OPD) years 2009-

	HbA1C		Foot exam		Retinal exam		Health Education		Diet/Nutrition Education		Exercise Education		Weight Reduction		Other Education		Referral	
Characteristic	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	**p value**	**OR (95% CI)**	p value	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
Provider																		
Physician	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Nurse Practitioner	2.47 (1.01-6.08)	0.049	0.86 (0.31-2.42)	0.776	1.05 (0.17-6.46)	0.207	0.74 (0.37-1.46)	0.381	0.50 (0.32-0.79)	0.003	0.50 (0.24-1.06)	0.072	0.66 (0.21-2.07)	0.470	1.02 (0.56-1.86)	0.951	1.77 (0.93-3.36)	0.081
Female	1.76 (1.2-2.57)	0.004	1.58 (0.6-2.92)	0.140	0.76 (0.40-1.44)	0.960	1.19 (0.86-1.65)	0.305	1.45 (0.96-2.18)	0.081	1.28 (0.75-2.20)	0.366	1.15 (0.74-1.79)	0.534	1.23 (0.90-1.69)	0.203	0.74 (0.54-1.02)	0.069
Age	1.00 (0.99-1.01)	0.705	1.00 (0.98-1.02)	0.793	0.99 (0.97-1.02)	0.399	0.99 (0.98-1.00)	0.058	0.99 (0.98-1.00)	0.050	0.99 (0.98-1.00)	0.032	0.98 (0.97-1.00)	0.022	1.00 (0.99-1.01)	0.617	1.03 (1.01-1.04)	<0.0001
Race																		
Caucasian	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
African American	1.71 (1.20 - 2.23)	0.042	0.85 (0.41-1.79)	0.813	0.48 (0.15-1.60)	0.540	0.81 (0.56-1.18)	0.237	0.99 (0.65-1.51)	0.080	0.59 (0.34-1.01)	0.211	1.13 (0.62-2.06)	0.051	1.16 (0.70-1.94)	0.408	1.22 (0.70-2.11)	0.731
Other	3.03 (2.01-4.05)	0.034	0.96 (0.40-2.32)	0.518	0.79 (0.29-2.18)	0.163	2.86 (1.00-8.23)*	0.013	1.28 (0.34-4.81)	0.209	0.69 (0.31-1.57)	0.187	1.18 (0.38-3.62)	0.118	3.97 (1.49-10.57)	0.003	2.55 (1.17-5.57)	0.012
Blank	0.14 (-0.76-1.04)	<0.0001	0.49 (0.13-1.76)	0.332	1.66 (0.39-7.12)	0.681	0.55 (0.21-1.44)	0.085	0.18 (0.09-0.38)	<0.0001	0.11 (0.05-0.26)	<0.0001	0.10 (0.02-0.42)	0.002	0.78 (0.30-2.05)	0.124	0.50 (0.18-1.40)	0.054
Ethnicity																		
Hispanic/ Latino	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Non-Hispanic/ Latino	0.43 (0.24-0.79)	0.006	0.86 (0.32-2.30)	0.764	3.05 (0.75-12.46)	0.121	0.78 (0.47-1.28)	0.320	0.80 (0.51-1.26)	0.329	0.85 (0.54-1.33)	0.471	0.77 (0.30-1.98)	0.587	0.61 (0.32-1.16)	0.130	0.86 (0.39-1.91)	0.710
Insurance type																		
Private	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Medicare	1.25 (0.90-1.73)	0.217	1.70 (1.13-2.58)	0.602	1.11 (0.56-2.20)	0.884	0.77 (0.55-1.07)	0.295	0.82 (0.59-1.13)	0.519	0.72 (0.49-1.05)	0.996	0.72 (0.33-1.55)	0.282	0.78 (0.54-1.13)	0.521	0.84 (0.57-1.26)	0.977
Medicaid	0.74 (0.37-1.45)	0.145	1.36 (0.83-2.24)	0.091	2.35 (0.88-6.30)	0.060	1.27 (0.69-2.32)	0.044	1.09 (0.63-1.89)	0.206	1.14 (0.58-2.23)	0.005	0.72 (0.27-1.90)	0.221	1.01 (0.63-1.60)	0.083	1.26 (0.84-1.89)*	0.029
Self-Pay	1.77 (0.41-1.42)	0.114	1.54 (0.82-2.90)	0.501	0.30 (0.05-1.68)	0.058	1.13 (0.64-2.00)	0.125	0.92 (0.52-1.62)	0.904	0.83 (0.29-2.38)	0.672	0.78 (0.33-1.83)	0.120	0.83 (0.46-1.48)	0.315	0.96 (0.54-1.73)	0.523
Other	1.96 (0.78-4.92)	0.076	6.09 (2.65-13.98)	0.000	1.66 (0.34-8.22)	0.507	0.49 (0.26-0.93)	0.008	0.73 (0.36-1.47)	0.357	0.28 (0.10-0.79)	0.008	0.09 (0.02-0.40)	0.001	0.26 (0.10-0.71)	0.008	0.41 (0.13-1.29)	0.128
Metropolitan Status																		
MSA	[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]		[reference]	
Non-MSA	1.57 (0.65-3.80)	0.317	1.83 (0.59-5.62)	0.294	0.56 (0.23-1.32)	0.181	1.80 (0.43-7.61)	0.422	2.07 (0.74-5.79)	0.167	3.52 (0.87-14.20)	0.080	0.85 (0.47-1.51)	0.573	2.44 (0.60-9.97)	0.212	1.05 (0.48-2.26)	0.910
Diagnosis of obesity	1.77 (0.95-3.31)	0.071	2.71 (1.21-6.08)	0.016	3.05 (1.67-5.57)	0.000	1.94 (1.26-2.99)	0.003	1.82 (1.28-2.59)	0.001	1.56 (0.93-2.59)	0.087	5.81 (3.49-9.67)	<0.0001	1.23 (0.70-2.16)	0.472	0.96 (0.59-1.58)	0.874
Previous visits	0.97 (0.93-1.02)	0.286	0.98 (0.94-1.02)	0.279	0.92 (0.81-1.04)	0.173	1.01 (0.99-1.03)	0.414	1.00 (0.98-1.03)	0.931	0.97 (0.93-1.01)	0.130	0.92 (0.88-0.96)	0.001	1.01 (0.99-1.04)	0.311	0.99 (0.97-1.02)	0.685
BMI	0.98 (0.95-1.01)	0.155	0.97 (0.93-1.00)	0.069	0.95 (0.91-0.99)	0.012	0.99 (0.97-1.01)	0.155	1.01 (0.99-1.03)	0.601	1.01 (0.99-1.04)	0.326	1.04 (1.01-1.06)	0.002	0.99 (0.97-1.01)	0.264	1.02 (1.00-1.05)	0.041
Current smokers	0.72 (0.42-1.24)	0.230	0.73 (0.51-1.05)	0.086	0.60 (0.20-1.82)	0.366	1.27 (0.82-1.98)	0.286	0.74 (0.49-1.10)	0.138	1.01 (0.69-1.48)	0.965	0.74 (0.40-1.35)	0.323	0.77 (0.51-1.16)	0.213	1.12 (0.73-1.72)	0.594

of care for diabetes treatment among patients treated in ambulatory care. The ambulatory model is adjusted for patient age, sex (using males as a reference), race (using whites as a reference), ethnicity (using Hispanic/Latino as a reference), number of previous visits, smoking status (using non-smokers as a reference), and BMI. After adjustment, receipt of 'Other' Education remained lower among NPs than MDs (0.18; 0.05-0.71; p 0.014). Health Education delivery was also 0.27 times lowers among NPs than the odds for an MD (0.27; 0.10-0.70; p 0.007). Irrespective of provider, patients with 'other' indemnity plans exhibited consistently higher odds of receiving all classified forms of Education. No other pattern of process of care delivery was consistently observed according to patient clinical or demographic characteristics after adjustment.

Table 3B shows adjusted regression analysis for process of care for diabetes treatment among patients treated in OPD. The OPD model is adjusted for patient age, sex, race, ethnicity, insurance type (using private insurance as a reference), number of previous visits, non-MSA (using MSA designated 'yes' as a reference), smoking status, obesity (using 'no' as a reference), and BMI. After adjustment, the odds of receiving HbA1c were 2.47 times larger than the odds when treated by an MD (2.47; 1.01-6.08; 0.049). The odds of receiving Diet/Nutrition counseling were 0.50 times smaller among NPs than among MDs (0.50; 0.32-0.79; p 0.003). Irrespective of provider, the odds of examination or patient-based education were consistently larger among patients who were diagnosed with obesity. Processes of care patters were not consistently observed across other clinical or demographic characteristics after adjustment.

Discussion

Previous studies have commented on the under-adherence to standards of care among NPs with respect to agree upon treatment standards for diabetes mellitus [17], while other studies have also identified increased adherence to the same standards [15,16,19]. The majority of studies, however, suggest that NPs can safely and effectively substitute for physicians for the treatment of diabetes [14,18,20]. However, much of the evidence for these findings comes from single clinics or hospital registries, which leaves open the question as to whether these findings can be considered nationally representative of current practice patterns. The present study examined the function of NPs using nationally representative surveys from ambulatory and outpatient emergency department visits. It also examined variations in treatment to patient-based educational and counseling to these same patients. Finally, it attempted to relate adherence to agree upon standards of care with respect to the clinical, demographic, and geographic profile of the patient as well as the setting where care was delivered.

Annually, there are approximately over 118 million ambulatory and 12 million OPD visits among adults with insulin dependent diabetes mellitus and noninsulin dependent diabetes mellitus captured within the NAMCS and NHMACS registries, respectively. The NAMCS is a nationally representative sample covering office-based practice of non-federally employed physicians whereas the NHAMCS-OPD covers nonfederal hospital outpatient department visits. With some important exceptions, the odds of receiving either agreed upon standards of care or patient-based education relevant to diabetes-related care is similar between NPs and MDs when assessed nationally using both datasets. However, there are some important distinctions with respect to how NP practice patterns are captured within each survey. For example, the NAMCS samples physicians as opposed to institutions whereas the NHAMCS is specific to institutions. In addition, the NAMCS captures NPs who work alongside physicians, but not NPs who have their own group practice. As such, the NAMCS likely under-estimates NP workload [21]. With this in mind, the findings generated from the NHAMCS that odds of adherence to standard practices of care are higher among NPs than MDs with respect to HbA1C likely provides a more nationally representative sample of NP care than does the NAMCS. In this vein, our findings support the results of previous studies also showing NPs have similar, if not better, adherence to care when compared to their physician counterparts, and do so using evidence that more likely characterizes the conditions that are occurring across the country.

With respect to patient-based education and counseling, there were some noticeable differences in practice patterns between providers. In the ambulatory setting, physicians were more likely to provide general health education and "other education." Physicians were more likely to provide diet/nutrition education in the OPD. These were unexpected findings due to the fact that it is expected that patient education is emphasized throughout nursing education [16]. It is also unexpected for this patient population because the nurse practitioners in this study were providing care to more complex patients, presuming that more complex patients would need more comprehensive education and counseling. Whether the difference may not be in the actual education or counseling provided, but rather in the documentation of education and counseling is unknown.

Nursing education has always focused on a holistic approach [2] with an emphasis on patient education, individualized care and open communication [22]. Our findings shows disconnect between nurse practitioner education and training with actual practice patterns. These differences should be investigated further with respect to other outcomes and disabilities. If these findings are robust, it would lend evidence in support of widening program education and training in order to determine the gap in education to practice. Once the gap is identified, education and training could be specially tailored so that nurse practitioners are trained and comfortable providing patient education.

Our findings also show that patients diagnosed as obese were more likely to receive foot exams, retinal exams, general health education, diet/nutrition education, and weight reduction education. The provision of diabetic related diagnostic tests for obese patients was not unexpected. Obesity frequently leads to the development of other comorbid conditions such as diabetes, coronary artery disease, hypertension, stroke, cancer, etc. [23,24]. Obesity and diabetes mellitus are commonly highly correlated conditions. It could be expected to have more closely monitored diagnostic tests for the obese population due to the

increased likelihood of complications from diabetes related to increased weight.

This study provides important and new evidence supporting the use of nurse practitioners as primary care providers; further research is needed to evaluate the health outcomes of patients cared for by nurse practitioners. Treatment of chronic conditions could be met through expanding access to mid-level care. Perhaps evidence showing similar or improved health outcomes from the practices of nurse practitioners would finally lead to increased scope of practice in the states providing reduced and restricted practices for nurse practitioners.

Study Limitations

This study had several limitations. First, the inclusion criteria, while necessary to generate the patient population, greatly reduced the number of patients seen by only nurse practitioners. Patients not included in this study may have been seen by multiple providers including a nurse practitioner. Second, there is no way to control for the possibility of a patient's preference or choice in care providers. Most studies find no difference in patient preference for provider [25,26] or increased preference for NPs [22,27,28]. Third, differences found in the education provided to patients from nurse practitioners compared to physicians may be due to patients having previous visits with the same provider. NPs treated patients with a higher number of previous visits. There is the possibility that the patient had received education at a previous visit, explaining why they did not receive education at the surveyed visit.

Conclusion

Overall, nurse practitioners had similar practice patterns with adherence to agree upon standards of practice in diabetes care to their physician counterparts. The results support the use of nurse practitioners as primary care providers for patients with diabetes. Nurse practitioners are competent to care for complex patients including those with a diagnosis of diabetes. The use of nurse practitioners will alleviate the increasing physician shortage and holds the potential to decrease cost while improving patient health outcomes in the primary care setting. Further research is needed to discern differences among studies in practice patterns between nurse practitioners and physicians. Further research also is needed to evaluate the gap in educating nurse practitioners on patient education and their provision of patient education in the clinical setting.

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Submitted: June 11, 2017; Accepted: June 20, 2017; Published: June 27, 2017