Health care costs associated with primary care physicians versus nurse practitioners and physician assistants

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ABSTRACT

Background: Significant primary care provider (PCP) shortage exists in the United States. Expanding the scope of practice for nurse practitioners (NPs) and physician assistants (PAs) can help alleviate this shortage. The Department of Veterans' Affairs (VA) has been a pioneer in expanding the role of NPs and PAs in primary caregiving.

Purpose: This study evaluated the health care costs associated with VA patients cared for by NPs and PAs versus primary care physicians (physicians).

Methods: A retrospective data analysis using two separate cohorts of VA patients, one with diabetes and the other with cardiovascular disease (CVD), was performed. The associations between PCP type and health care costs were analyzed using ordinary least square regressions with logarithmically transformed costs.

Results: The analyses estimated 12% to 13% (US dollars [USD] 2,626) and 4% to 5% (USD 924) higher costs for patients assigned to physicians as compared with those assigned to NPs and PAs, after adjusting for baseline patient sociodemographics and disease burden, in the diabetes and CVD cohort, respectively. Given the average patient population size of a VA medical center, these cost differences amount to a total difference of USD 14 million/year per center and USD 5 million/year per center for diabetic and CVD patients, respectively.

Implications for practice: This study highlights the potential cost savings associated with primary caregiving by NPs and PAs. In light of the PCP shortage, the study supports increased involvement of NPs and PAs in primary caregiving. Future studies examining the reasons for these cost differences by provider type are required to provide more scientific evidence for regulatory decision making in this area.

Keywords: Cardiovascular disease; diabetes; health care costs; nurse practitioners; physician assistants; physicians.

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Introduction

The United States has had considerable primary care provider (PCP) shortages for many decades, with fewer providers per capita and longer waiting lines (American Association of Medical Colleges, 2019; Organization for Economic Corporation and Development, 2012; Schoen et al., 2011). Less than 30% of current physicians are primary care physicians, and only 25% of physicians in training aspire to be in primary care (Agency for Health care Research and Quality, 2011; Schwartz, 2012). With an increase in population and aging of the population, there is a growth in demand for primary care, which is further worsening the shortage.

Many stakeholders and organizations, like the Institute of Medicine (IOM), are suggesting regulatory changes for expanding the scope of practice (SOP) for nurse practitioners (NPs) and physician assistants (PAs) in primary caregiving to address this shortage (American Association of Nurse Practitioners, 2015; Auerbach et al.,

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2013; Health Resources & Services Administration, 2013; IOM, 2010; Robert Wood Johnson Foundation, 2013; Timmons, 2017). Consequently, hospitals, health systems, health maintenance organizations, and insurance companies need to expand their practice models to include NPs and PAs as PCPs. Studies supporting expanded roles of NPs and PAs in primary care argue that they provide similar quality of care, with statistically equivalent patient outcomes and similar intensity of care, as compared with physicians (Mundinger et al., 2000; Timmons, 2017; Virani et al., 2015, 2016). In addition, increased participation by NPs and PAs in primary caregiving improves access to care and quality of care (Oliver et al., 2014) and possibly reduces health care costs. Increased participation of NPs and PAs will improve access because more NP/PA participation will increase the number of PCPs available to the population. In addition, the improved access will reduce preventable hospitalizations and emergency department visits and enhance quality of care and health outcomes (Oliver et al., 2014). Cost reductions could be due to improved timely access to primary care, as a result of increased availability of providers, which prevents the need for emergency care, hospitalizations, and high-cost therapies, and/or it could be due to the lower reimbursements associated with NPs and PAs as compared with physicians.

The first study (Timmons, 2017) that examined the impact of PCP type on costs used Medicaid claims data (up to 2012) and estimated an 11.8% to 14.4% reduction in outpatient costs associated with NPs and PAs versus primary care physicians (henceforth referred to as physicians). Two recent studies examined health care costs associated with physicians versus NPs and PAs using a diabetic cohort in the Veterans Affairs (VA) (Morgan et al., 2019; Smith et al., 2020). However, these studies only examined VA costs and did not examine costs for other chronic complex high-cost diseases, such as cardiovascular disease (CVD). Consequently, there is a dearth of information about the impact of physicians versus NPs and PAs on overall health care costs, and more evidence will help highlight the benefits of expanding NP and PA SOP.

To improve primary care access for its patients, the U.S. Department of VA was one of the first providers in the nation to expand the SOP for NPs and PAs (Moran et al., 2016; Department of Veteran Affairs [DVA], 2016). Given the organization's long-standing expansive employment of NPs and PAs, it is important to assess the costs associated with the use of physicians versus NPs and PAs in the VA. This study uses patient-level VA data to examine both VA and Medicare costs associated with the different PCP types. The findings of this study will contribute to the gap in the literature regarding the economics of employing NPs and PAs versus physicians.

The study uses two cohorts of patients, one with a prior diagnosis of diabetes and the other with prior diagnosis of CVD. Cardiovascular disease in this study included ischemic heart disease (IHD), ischemic cerebrovascular disease (ICVD), and peripheral artery disease (PAD). Both diseases require regular monitoring by PCPs. Timely medical interventions and drug modifications in these diseases can prevent a variety of complications, morbidity, and mortality. Hence, examining the impact of PCP types is particularly important for these diseases.

Methods

Study design and sample

This retrospective data analysis used a cohort of patients, 22 years and older, previously diagnosed with diabetes or CVD, and receiving outpatient care at the VA in the United States. The majority of patients in the study cohort also received inpatient care at the VA, but only outpatient care was required to be part of the study. Two cohorts, one for patients with diabetes (diabetes cohort) and the other for patients with CVD (CVD cohort), were created and analyzed separately. The claims-based algorithm used to create these cohorts are described in previous publications (Hira et al., 2016; Pokharel et al., 2016; Virani et al., 2016, 2018). The latest primary care visit for federal fiscal year 2013 (October 1, 2012 to September 30, 2013) was used as the index date. All claims for up to 365 days after this index date were obtained, and costs were computed for this follow-up period. All independent variables were measured at the index date or during the 365 days before the index date.

The patient's type of PCP was based on the PCP assigned on the index date, and was classified as a physician or NP/PA. If there was no provider assignment on the index date, then the last physician or NP/PA assigned during 180 days before the index date was considered the PCP. Hence, the time between the index date and 180 days before the index date is the *index period* for determining the type of provider. Data about type of PCP were retrieved from the VA corporate data warehouse's 'Current Provider Team Membership' file. It was noted that NP and PA providers were not always classified as different provider types within the system, hence NPs and PAs were considered together for purposes of the analysis.

Patients with the following characteristics were excluded: (1) patients who had metastatic cancer and those receiving hospice care (these patients were excluded to avoid including end-of-life care costs); (2) patients who did not have a unique identifying number in VA's corporate data warehouse data, health economics resource center data, and the managerial cost accounting data; (3) patients who were not classified as veterans; (4) patients with missing vital status file, gender, or date of birth; and (5) erroneous patient files with date of death before the index date.

Patient files with the following PCP assignment ambiguities were excluded: (1) If no provider was assigned during the index period, or if the physician or NP/PA assignment during the index period ended on or before the index date, and no new physician or NP/PA was assigned during the follow-up period; (2) If more than one provider was assigned on the index date or more than one provider was assigned for the same latest date within the 180 days before the index date; (3) If the patient was assigned to a new provider during follow-up and this new provider happened to belong to the other provider type; (4) If the provider assigned during the index period was a specialist (physician/nurse) or a resident in training; (5) If there was a change in provider assignment during the 365 day follow-up period and the new provider was a specialist or a resident in training; (6) If the provider type was labeled inconsistently between different patients, for example, if provider X was labeled as a PA for 10% of her/his patients, and labeled as a physician for the remaining 90% of her/his patients.

Dependent variables

The analyses focused on two main dependent variables. The first was the total VA costs incurred by the patients during the 365 days after the index date (VA costs), and the second was the sum of total VA and Medicare costs incurred by the patients during the 365 days after the index date (total costs). Because VA patients can be insured through payers outside the VA, cost analyses only focusing on VA costs might be biased, especially if the level of outside insurance and dependence on the VA varies by provider type. Medicare is the largest payer for VA patients outside the VA system (Humensky et al., 2012); hence, this study uses Medicare cost information in addition to VA costs.

Because most of the chronic disease care for a patient is delivered in the outpatient setting, primary care clinicians play an important role in the use of diagnostic and laboratory services, and the prescription of medications. Once hospitalized, inpatient service use and length of stay are often influenced by hospitalists and other specialists caring for patients at the inpatient facilities. Hence, this study also aimed to examine if the type of PCP has a differential association with inpatient, outpatient, and pharmacy costs.

Independent variables

All regression analyses adjusted for three groups of independent variables—patient demographic, patient clinical, and provider characteristics. Patient demographic characteristics included age on the index date measured in years, gender, race ethnicity, marital status as of the index date, insurance status based on the presence of additional insurers outside the VA during the 365 days before the index date, extent of reliance on the VA 365 days prior to the index date, and urbanicity of patient's place of residence. Extent of reliance on the VA for a period was defined as the proportion of patient care costs (for all services) borne by the VA in relation to the total patient care costs (for all services) borne by both the VA and Medicare for that period.

Both the diabetes and the CVD cohort regressions controlled for patient clinical characteristics, which included four binary variables capturing whether the patient had a history of IHD, ICVD, PAD, and hypertension (HTN), and a continuous variable capturing the VA-based Nosos risk score. The Nosos risk score uses a person's International Classification of Diseases, Ninth Revision, Clinical Modification or, International Classification of Diseases, Tenth Revision, Clinical Modification diagnosis codes from the VA claims data to develop a risk score capturing disease burden. This risk score can be used in regression analyses to control for confounding due to baseline disease burden (Virani et al., 2015, 2016; Wagner et al., 2016). For the CVD cohort, an additional binary variable capturing whether the patient had a history of diabetes was also included.

Provider characteristics included type of PCP assigned to the patient during the index period. In addition, provider age on the index date measured in years, provider gender, and teaching facility status of the patient's clinic or medical center were also controlled for.

Analysis

The study descriptively examined the characteristics of patients assigned to a physician versus an NP/PA for both the diabetes and CVD cohort (**Table 1**, Supplemental Digital Content 1, http://links.lww.com/JAANP/A124) and also examined the average cost differences between patients assigned to a physician versus an NP/PA (**Table 1**). The cost variables were predominantly right skewed, and based on tests of the cost variable distributions, Wooldridge R-square test comparing nonnested models (Wooldridge, 2020), and a Box–Cox specification test, it was decided that the dependent variables will be logarithmically transformed before the regression analyses. Based on the algorithm outlined by Manning and Mullahy (2001), the ordinary least square regression of the logarithmically transformed dependent variables was preferred over the generalized linear model with a log-link function. Stepwise regression methods and bivariate analyses were performed to finalize the inclusion of the independent variables in the final modal. Higher-order terms for the continuous variables and interactions were tested, and the square of patient age and PCP age were included. Regression analyses were performed for the VA and total costs (**Table 2**), as well as inpatient, outpatient, and pharmacy components of both VA and total costs (**Table 3**). The marginal effects presented in both **Tables 2 and 3** are obtained by adjusting the beta coefficients from the regressions using the Halvorson–Palmquist

Table 1. VA and total costs associated with diabetic and CVD patients by type of provider

	Diabetes Cohort		CVD Cohort	
	Patients Assigned to Physician Providers (n = 725,097)	Patients Assigned to NP or PA Providers (n = 228,790)	Patients Assigned to Physician Providers (n = 914,389)	Patients Assigned to NP or PA Providers (n = 227,703)
VA costs				
Outpatient	6,561	5,297	5,556	4,888
Inpatient	3,883	2,881	3,817	3,200
Pharmacy	1,446	1,169	1,207	1,073
Total VA costs	11,890	9,346	10,580	9,160
Medicare costs				
Outpatient	1,871	2,106	2,679	2,846
Inpatient	2,544	2,645	3,527	3,647
Pharmacy	175	218	218	237
Total Medicare costs	4,590	4,969	6,424	6,729
Total costs				
Outpatient	8,432	7,403	8,235	7,734
Inpatient	6,427	5,525	7,344	6,847
Pharmacy	1,621	1,387	1,426	1,309
Total costs	16,480	14,316	17,004	15,890

Note: CVD = cardiovascular diseases; NP = nurse practitioner; PA = physician assistant; VA = Veteran's Affairs. All values are in US dollars.

correction and multiplying by 100 for a percentage interpretation.

The investigators only had access to Medicare pharmacy claims/cost data up to calendar year 2013 because Medicare pharmacy claims data are sent to the VA on a calendar year basis and not a fiscal year basis. Hence, the pharmacy costs included in the total costs were censored at December 31, 2013. Sensitivity analyses to assess the robustness of the results for total costs were performed due to the unusual censoring of the Medicare pharmacy cost data. A total cost regression excluding the censored Medicare pharmacy costs and another including Medicare pharmacy costs for the entire calendar year 2013 (instead of 365 days from the index date) were performed. All analyses were performed using Stata 14. The study protocol was approved by the Institutional Review Boards at Baylor College of Medicine and the Michael E. DeBakey VA Medical Center.

Results

Before the exclusions, the data had 1,177,607 patients in the diabetes cohort and 1,337,484 patients in the CVD cohort. Nineteen percent of the patients in the diabetes cohort and 15% of the patients in the CVD cohort were excluded as described above. The final cohorts included 953,887 and 1,142,092 patients for diabetes and CVD, respectively. Twenty-four percent of the diabetes cohort and 19% of the CVD cohort were assigned to NPs/PAs.

In the diabetes cohort (**Table 1**, Supplemental Digital Content 1, http://links.lww.com/JAANP/A124), patients assigned to physicians and NPs/PAs had similar average age on the index date, gender distribution, marital status distribution, insurance status distribution, and history of CVDs (IHD, ICVD, PAD) and HTN. A higher proportion of patients assigned to physicians were racial ethnic minorities (35% vs. 28%), lived in urban areas of residence (63% vs. 52%), and were part of a facility that was a teaching facility (44% vs. 36%) as compared with those assigned to NPs/PAs. Patients assigned to physicians had a higher reliance on the VA than on Medicare (84% vs. 79%) and also had higher baseline Nosos risk scores (1.67 vs. 1.34) as compared with those assigned to NPs/PAs. As expected, physicians were more often men as compared with NPs/PAs (46% vs. 19%); however, the average age of physicians and NPs/PAs were similar. The CVD cohort

Table 2. Marginal effect of patient and provider characteristics on VA and total costs based on multiple linear regression

	Diabetes Cohort		CVD Cohort	
	VA Costs	**Total Costs**	**VA Costs**	**Total Costs**
Patient demographic characteristics				
Age	4.75 (4.56, 4.95)	1.47 (1.28, 1.65)	2.18 (1.94, 2.42)	−2.38 (−2.61, −2.15)
Age square	−0.04 (−0.04, −0.04)	−0.01 (−0.01, −0.01)	−0.02 (−0.02, −0.02)	0.02 (0.01, 0.02)
Gender (male)	−7.25[a] (−8.43, −6.07)	−7.71 (−8.85, −6.56)	−9.79 (−11.30, −8.26)	−9.48 (−10.94, −8.00)
Race/ethnicity				
Non-Hispanic Black	5.41 (4.71, 6.12)	4.98 (4.31, 5.66)	10.19 (9.30, 11.09)	10.90 (10.04, 11.76)
Hispanic	2.64 (1.64, 3.64)	−2.03 (−2.95, −1.10)	8.03 (6.76, 9.32)	1.60 (0.45, 2.76)
Other	−15.27 (−15.98, −14.56)	−8.40 (−9.16, −7.64)	−16.89 (−17.49, −16.29)	−7.88 (−8.58, −7.18)
Marital status	−0.10 (−0.61, 0.41)	−1.70 (−2.18, −1.22)	−0.88 (−1.37, −0.39)	−3.13 (−3.60, −2.66)
Insurance status				
Privately insured	−34.47 (−34.97, −33.96)	−38.08 (−38.55, −37.61)	−37.73 (−38.20, −37.25)	−46.53 (−46.94, −46.11)
Privately and publicly insured	−9.52 (−10.06, −8.98)	−5.58 (−6.12, −5.03)	−9.47 (−9.94, −8.99)	−4.74 (−5.24, −4.24)
Other	−22.31 (−22.87, −21.74)	−22.31 (−22.87, −21.75)	−24.50 (−25.12, −23.88)	−25.67 (−26.27, −25.06)
Reliance on VA	212.89 (209.82, 216.00)	−54.62 (−55.05, −54.17)	244.06 (241.50, 246.64)	−53.00 (−53.36, −52.64)
Place of residence (urban)	10.64 (10.09, 11.19)	9.30 (8.78, 9.83)	8.67 (8.17, 9.17)	7.92 (7.43, 8.42)
Patient clinical characteristics				
History of IHD	14.57 (13.97, 15.18)	17.74 (17.14, 18.34)	10.74 (9.95, 11.54)	13.89 (13.10, 14.68)
History of ICVD	3.46 (2.62, 4.31)	6.72 (5.91, 7.54)	6.76 (6.09, 7.44)	9.75 (9.09, 10.42)
History of PAD	5.54 (4.48, 6.61)	11.65 (10.60, 12.71)	8.05 (7.30, 8.79)	14.60 (13.84, 15.36)
History of HTN	25.22 (24.39, 26.06)	21.11 (20.31, 21.91)	20.55 (19.85, 21.25)	15.26 (14.57, 15.96)
History of diabetes	—	—	21.54 (20.99, 22.10)	24.48 (23.92, 25.05)
Nosos	24.76 (24.51, 25.01)	25.22 (24.99, 25.45)	23.79 (23.56, 24.03)	24.37 (24.16, 24.58)
Provider characteristics				
Type of provider (physician)	12.78 (12.14, 13.43)	12.49 (11.86, 13.13)	4.83 (4.24, 5.43)	4.31 (3.72, 4.90)
Teaching facility	16.55 (15.97, 17.13)	12.47 (11.94, 13.01)	21.39 (20.81, 21.98)	15.27 (14.73, 15.81)
Age	−0.29 (−0.54, −0.04)	−0.12 (−0.37, 0.12)	−0.55 (−0.80, −0.31)	−0.60 (−0.84, −0.36)
Age square	0.002 (−8.3E-06, 0.005)	0.001 (−0.001, 0.003)	0.005 (0.003, 0.007)	0.005 (0.003, 0.008)
Gender (male)	−3.38 (−3.90, −2.85)	−3.30 (−3.80, −2.79)	−3.51 (−4.00, −3.01)	−3.38 (−3.87, −2.88)

Note: CVD = cardiovascular diseases; HTN = hypertension; ICVD = ischemic cerebrovascular disease; IHD = ischemic heart disease; PAD = peripheral artery disease; VA = Veteran's Affairs.
[a]*Marginal effect can be interpreted as follows: On an average, ceteris paribus, diabetic men have 7.25% lower VA costs than diabetic women.*

(**Table 1**, Supplemental Digital Content 1, http://links.lww.com/JAANP/A124) had similar distributions of patient and provider characteristics as the diabetes cohort described above. Except for "history of IHD" in the CVD cohort, all mean and frequency differences exhibited in **Table 1** (Supplemental Digital Content 1, http://links.lww.com/JAANP/A124) for both diabetes and CVD cohorts are statistically significant, with a *p* value of <.05.

Table 3. Marginal effect of type of provider on outpatient, inpatient, and pharmacy costs based on multiple linear regression

	Diabetes Cohort		CVD Cohort	
	VA Costs Marginal Effect (95% Confidence Interval)	Total Costs Marginal Effect (95% Confidence Interval)	VA Costs Marginal Effect (95% Confidence Interval)	Total Costs Marginal Effect (95% Confidence Interval)
Outpatient	13.71[a] (13.02, 14.40)	12.87 (12.21, 13.53)	5.39 (4.77, 6.02)	3.77 (3.17, 4.38)
Inpatient	1.16 (−0.13, 2.46)	8.14 (6.29, 10.01)	1.99 (0.71, 3.28)	3.25 (1.38, 5.16)
Inpatient (excluding patients not admitted)	−0.27 (−2.18, 1.69)	0.36 (−0.98, 1.72)	1.24 (−0.60, 3.12)	1.16 (−0.006, 2.34)
Pharmacy	18.59 (17.53, 19.66)	14.32 (13.36, 15.29)	4.84 (3.86, 5.83)	4.28 (3.38, 5.19)

Note: CVD = cardiovascular diseases; NP = nurse practitioner; PA = physician assistant; VA = Veteran's Affairs.
[a]Marginal effect can be interpreted as: On an average, ceteris paribus, being assigned to a physician increases the outpatient costs by 13.71% as opposed to being assigned to an NP or PA.

Based on the descriptive statistics (**Table 1**), VA and total costs were US dollars [USD] 1,000–2,000 higher for patients assigned to physicians as compared with those assigned to NPs/PAs for both the diabetes and CVD cohort. The adjusted regression analyses (**Table 2**) estimated 12% to 13% higher costs for patients assigned to physicians as compared with those assigned to NPs/PAs in the diabetes cohort, but only 4% to 5% higher costs in the CVD cohort. In dollar amounts, patients assigned to physicians had USD 1,893 higher VA costs and USD 2,626 higher total costs as compared with those assigned to NPs/PAs in the diabetes cohort. Similarly, patients assigned to physicians had USD 617 higher VA costs and USD 924 higher total costs as compared with those assigned to NPs/PAs in the CVD cohort. Sensitivity analyses performed by excluding Medicare pharmacy costs from the total costs or including the entire 2013 calendar year of Medicare pharmacy costs to the total costs made no difference to the estimated coefficients (results not shown).

In both the diabetes and CVD cohorts (**Table 2**), higher age, being a woman, belonging to a racial ethnic minority group, having additional public insurance, being more reliant on the VA during the previous year, living in an urban area, having any CVD, having a higher Nosos risk score, belonging to a teaching facility, and having a younger and female provider increased the VA costs. Total costs showed similar associations with the independent variables in both diabetes and CVD cohorts, except being currently married and being more reliant on the VA reduced total costs in both cohorts. Having a history of diabetes increased VA and total costs for the CVD cohort.

Regression analyses examining individual components of costs in the diabetes cohort (**Table 3**) demonstrated that the VA and total outpatient costs were 13% higher among patients assigned to physicians as compared with those assigned to NPs/PAs. VA and total pharmacy cost differences were even higher at 14% to 19%. Inpatient costs between the two groups were not very different (especially if the analysis was restricted to only those patients hospitalized). An exception was the total inpatient cost, which was 8% higher in patients assigned to physicians as compared with those assigned to NPs/PAs.

Regression analyses examining individual components of costs in the CVD cohort (**Table 3**) demonstrated a 4% to 5% difference in VA/total outpatient and pharmacy costs. Similar to the diabetes cohort, inpatient costs between the two groups were not very different but still stood at 2% to 3% if both hospitalized and non-hospitalized patients were included in the analyses.

Discussion

This study found that diabetic patients assigned to physicians had 12% higher health care costs as compared with those assigned to NPs/PAs during the year following a primary care visit, after adjusting for baseline patient sociodemographics and disease burden. Similarly, among CVD patients, those assigned to physicians had 4% higher costs. The findings from this study are very similar to Timmons (2017) examination of Medicaid claims, which showed 11.8% to 14.4% reduction in outpatient costs associated with NPs/PAs versus physicians.

Higher cost differences between patients assigned to physicians versus NPs/PAs in the diabetes cohort as compared with the CVD cohort could be attributed to the fact that diabetes requires more frequent outpatient primary care management in terms of counseling, dietetic management, drugs, and insulin administration. Cardiovascular disease on the other hand might have a large inpatient or surgical expenditure often managed by specialists, with relatively less involvement from PCPs. Hence, the type of PCP might have a much larger impact on diabetes management costs than on CVD management costs. As expected, the type of PCP had a much larger impact on outpatient and pharmacy costs in both diabetic and CVD patients and negligible impact on inpatient costs.

There are several possible explanations for the cost difference between NPs/PAs and physicians. First, patients assigned to physicians might have a higher disease burden as compared with those assigned to NPs/PAs (Dahrouge et al., 2014). Nevertheless, this study homogenized the comparison groups by first creating chronic disease–specific cohorts and then controlling for the disease burden using the Nosos risk score. Second, NPs/PAs might be less aggressive in the use of diagnostic modalities and therapies. Studies examining NP/PA and physician practice patterns are required to test this possibility. Third, NPs/PAs might be more accessible (both for in-person visits and consultations over the phone) for timely care provision as compared with physicians, thereby improving quality of care and reducing costs. This possibility has been suggested by other authors and needs to be examined further (Morgan et al., 2014; Oliver et al., 2014).

The findings from this study suggest that it is highly likely that NPs/PAs reduce costs for patients, improve access, and ensure efficient provision of high-quality care. On an average, a VA medical center (VAMC) and its satellite clinics have an average of 7,394 diabetic patients and 8,853 CVD patients. Given the projected cost difference per patient in this study, a VAMC stands to save USD 14 million/year and USD 5 million/year for its diabetic and CVD patients, respectively, with the use of NPs/PAs (instead of physicians), if all cost differences estimated in this study are due to efficient caregiving by NPs/PAs. Even if some of these cost differences are due to unobserved heterogeneity in the patient population, the total differences are large enough to warrant further exploration of these potential savings. It is also important to note that these amounts do not include the potential cost savings due to differences in NP/PA and physician salaries for the VA. This study is highly supportive of VA's initiative to expand NP/PA participation (DVA, 2016; Moran et al., 2016) and provides further evidence to policy makers and health care administrators hoping to resolve the national PCP shortage.

The study has some limitations. First, this is an observational study; hence, unobserved heterogeneity between patients assigned to NPs/PAs and physicians might exist. Second, the study is specific to the VA and might not be generalizable to other health care systems. Third, the study only examines follow-up costs for one year and does not include long-term costs. Nevertheless, this study is a critical step in understanding cost differences in patient care between NPs/PAs and physicians and paves the way for future evaluations.

In conclusion, this study highlights the potential cost savings associated with primary caregiving by NPs and PAs. In light of the PCP shortage, the study provides evidence to policy makers and administrators for increasing the involvement of NPs and PAs in primary caregiving. The study also supports expanding educational budgets for training more NPs and PAs. Future studies examining the reasons for cost differences between patients served by NPs and PAs versus physicians are required to provide more scientific evidence for political and regulatory decision making in this area. Particularly, incorporating NP/PA versus physician salary information in the economic evaluations comparing care provision by these two groups will be critical.

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