

ORIGINAL RESEARCH: EMPIRICAL RESEARCH – QUANTITATIVE

Does primary care diabetes management provided to Medicare patients differ between primary care physicians and nurse practitioners?

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Abstract

Aims. The aim of this study was to answer the overall question: Does primary care diabetes management for Medicare patients differ in scope and outcomes by provider type (physician or nurse practitioner)?

Background. In the USA as well as globally, there is a pressing need to address high healthcare costs while improving healthcare outcomes. Primary health care is one area where healthcare reform has received considerable attention, in part because of continued projections of primary care physician shortages. Many argue that nurse practitioners are one solution to ease the consequences of the projected shortage of primary care physicians in the USA as well as other developed countries.

Design. Cross-sectional quantitative analysis of 2012 Medicare claims data.

Methods. A 5% Standard Analytic File of 2012 Medicare claims data for beneficiaries with Type 2 diabetes were analysed. A medical productivity index was used to stratify patients as healthiest and least healthy who were seen by either nurse practitioners only or primary care physicians exclusively. Included in the analyses were health services utilization, health outcomes and healthcare cost variables.

Results. The patients in the nurse practitioner only group, overall and stratified by medical productivity index status, had significantly improved outcomes compared with all primary care physician provider groups regarding healthcare services utilization, patient health outcomes and healthcare costs.

Conclusions. These findings inform current healthcare workforce conversations regarding healthcare quality, outcomes and costs. Our results suggest nurse practitioner engagement in chronic care patient management in primary care settings is associated with lower cost and better quality health care.

Keywords: healthcare cost comparisons, healthcare reform, Medicare beneficiaries, nurse practitioners, primary care physicians

Why is this research needed?

- In the USA as well as in other developed countries, there is a pressing need to address high healthcare costs while improving healthcare outcomes.
- There is also consensus about the existence of a primary care provider shortage that and nurse practitioners are one solution to easing the consequences of the shortage of primary care providers.
- Despite positive patient outcome data attributed to care received by nurse practitioners, there continue to be many states and developed countries that maintain restrictions on nurse practitioner licenses suggesting that there is a need for more research examining health outcomes and costs where nurse practitioners are concerned.

What are the key findings?

- Results suggest nurse practitioner engagement in chronic care patient management is associated with lower cost and better quality care.
- We had four key findings: (1) patient case-mix, using ICD-9 codes diagnoses, was similar across medical productivity index categories and provider type; (2) healthcare utilization was significantly different by medical productivity index categories and provider type; (3) patient outcomes were at times similar and significantly different by medical productivity index categories and provider type and (4) healthcare costs were significantly different by medical productivity index categories and provider type.

How should the findings be used?

- The findings from the study reported on here inform the current healthcare workforce conversations regarding healthcare quality, healthcare outcomes and healthcare costs as these relate to nurse practitioners and/or primary care physicians.
- These findings should be taken seriously by states and other developed countries that continue to place restrictions on nurse practitioner licensure and practice.

Introduction

In the USA in 2012, there were approximately 49.5 million Medicare beneficiaries (Kaiser Family Foundation 2014a) accounting for an estimated 21% of the total healthcare spending in the USA (California Healthcare Foundation 2014) and 13% of the US federal budget (Kaiser Family Foundation 2014b). While the Medicare share of total US healthcare expenditure has varied little from one year to the next, Medicare costs have been growing, although at a declining rate (Centers for Medicare and Medicaid Services 2012).

Medicare is a 50-year old US government health insurance programme that was written into law on 30 July 1965, as Title XVIII of the Social Security Act, becoming effective on 1 July 1966. The programme's intent was to provide health insurance protection for those ≥ 65 years of age. Medicare's primary goal was to increase access to healthcare services and to reduce the financial burden of the high costs of medical care. Since becoming effective in 1966, the programme has been amended several times, although its initial intent remains intact. Medicare is administered by the Centers for Medicare and Medicaid (CMS), a component of the US Department of Health and Human Services. Despite the recent slowing of healthcare spending, USA continues to face pressures to reduce healthcare costs while also improving health outcomes to meet growing healthcare demand with an ageing population (Berwick *et al.* 2008, Oliver *et al.* 2014, United States Health and Human Services 2014).

Background

The primary healthcare system is facing pressure to manage an ageing population as it simultaneously faces pressure of increasing patient volume due to health insurance expansion from the Affordable Care Act (ACA) (Sisko *et al.* 2010, Hofer *et al.* 2011). In anticipation of the growing demand, projections suggest that the USA will face a shortage of primary care physicians (Mitka 2007, Steinwald 2008, Green *et al.* 2013). Whether or not an *overall* physician shortage exists is debatable, nonetheless, there is considerable consensus about the existence of a primary care physician shortage (Mitka 2007, Steinwald 2008, Hofer *et al.* 2011, Bodenheimer & Smith 2013, Green *et al.* 2013). The current model of primary care is not static and in many places, is undergoing change with the adoption of models such as patient-centered medical homes (PCMH) (Newhouse *et al.* 2011, Emanuel *et al.* 2012, Ghorob & Bodenheimer 2012, Bodenheimer & Smith 2013, Green *et al.* 2013, Iglehart 2013). PCMHs are a way of organizing primary health care that emphasizes patient care coordination and communication to transform primary care into what patients want and/or need it to be (Jackson *et al.* 2013). Many believe that PCMHs can lead to higher quality health care and lower associated healthcare costs and can improve patients' and providers' experience/satisfaction with health care provided and/or received (Jackson *et al.* 2013).

Healthcare teams have also been introduced as a solution to the strain produced by the shortage of primary care providers (Institute of Medicine 2010, Fairman *et al.* 2011,

Emanuel *et al.* 2012, Ghorob & Bodenheimer 2012). The specific team configuration of professions – clinician and non-clinician – is not always the same, some include nurse practitioners (NPs) (Auerbach 2012, Emanuel *et al.* 2012, Iglehart 2013) and others not (Ghorob & Bodenheimer 2012). Greater leverage of NPs as the lead of healthcare teams has been proposed as one solution to easing the consequences of the shortage of primary care physicians (Auerbach 2012, Bodenheimer & Smith 2013, Iglehart 2013). The major ecological variables limiting consensus on the role of NPs on healthcare teams are, for the most part, due to physician concerns. For example, in 2012 the American Academy of Family Physicians stated that healthcare quality would be compromised if NPs led PCMHs (CMS 2012).

These concerns have limited NP scope of practice between different US states (Fairman *et al.* 2011, Emanuel *et al.* 2012, Bodenheimer & Smith 2013, Iglehart 2013). A 2011 systematic review of literature on advanced practice nurses (APN) (of which NPs constitute the majority proportion) outcomes spanning 18 years concluded that APN outcomes were just as good and in some instances, better than those for physicians practicing alone (Newhouse *et al.* 2011). A 2014 study found that states that have regulations supporting the full practice of NPs vs. states with more restricted scope of practice correlate with significantly improved health outcomes for Medicare or Medicare-Medicaid beneficiaries (Centers for Medicare and Medicaid Services 2012). Despite the patient outcome data attributed to care received by NPs, there continue to be many US states that maintain restrictions on NP licenses suggesting that there is a need for more research examining health outcomes and costs where NPs are concerned. Restricted practice for NPs, however, is not unique to the US healthcare system, nor is the need for high quality care and reduced care costs (Kilpatrick *et al.* 2015, Marshall *et al.* 2015, Martin-Misener *et al.* 2015). Other developed countries such as the UK (Marshall *et al.* 2015), Ireland (Begley *et al.* 2015), the Netherlands (Dierick-van Daele *et al.* 2009), Portugal (Temido & Dussault 2015) and Canada (Markle-Reid *et al.* 2013, Kilpatrick *et al.* 2015) share these concerns. The similarities across developed countries are remarkable. Of difference, however, is the higher degree of integration of NPs in the US healthcare system when compared with other developed countries. The US experiences may inform policy and workforce pathways for other developed countries. This study sought to answer the overall question: Does primary care type 2 diabetes (DM2) management for Medicare patients differ by provider type (physician or NP)?

The study

Aims

In this study, we compared how primary care physicians and NPs differ in their care practice, patient outcomes and healthcare costs. We focused our analysis on Medicare patients with the diagnosis of DM2 and who are being treated in primary care offices. We chose DM2 because it is an age-prevalent chronic condition with an estimated 20% of US adults aged 65 and older having the disease. Moreover, the health-related outcomes for DM2 are well-defined. In this study, we examine whether the following patient level factors vary by primary care physicians vs. NPs: (1) the prevalence of comorbid disease; (2) patient outcomes; and (3) healthcare costs.

Design

We conducted a cross-sectional retrospective study using the 2012 US Medicare National Claims History file for analysis. These data are commonly known as the five per cent Standard Analytic File (SAF).

Participants

Claims data from Medicare's five per cent Standard Analytic File (SAF) – a random sample of 5% of all beneficiaries of the Medicare population with services provided in the 2012 calendar year – was analysed for this study. The vast majority, although not all Medicare patient participants, were ≥ 65 years of age. All study participants were Medicare beneficiaries receiving care in 2012 for DM2.

Data collection

This was a big data research project entailing the analysis of secondary Medicare claims data. All data extraction was performed using SAS version 9.3 (Cary, NC, USA). From the 2012 Medicare five per cent SAF we selected Medicare beneficiaries with DM2 according to the broad three-digit ICD-9 code (250.0). This specific ICD-9 code represents DM2 or unspecified, without mention of complication and not stated as uncontrolled. The sample was further restricted to those who was seen in a primary care setting by one of two billing provider types: primary care physician (family practice or internal medicine) or NP. We only included patients who exclusively saw a primary care physician without any follow-up by an NP and patients who

exclusively saw an NP without any follow-up by a primary care physician. Patients who saw a physician followed by an NP or patients who saw an NP followed by a primary care physician were excluded from the analysis. Figure 1 is a flow chart depicting the sample selection process. Of importance, 271,003 unique patients were identified as those having a diagnosis of DM2 and as being seen either by a primary care physician exclusively or an NP exclusively. From those unique patients, 199,185 were seen exclusively by primary care physicians for 1,240,927 encounters (visits) with unique ICD-9 codes, 4,385 were exclusively seen by NPs for 14,312 encounters (visits) with unique ICD-nine coded diagnoses.

Ethical considerations

The Institutional Review Boards (IRBs) at the researchers' institutions recognize that the analysis of de-identified

secondary data does not constitute human subjects research as defined in US federal regulations and as such does not require human subjects IRB review or oversight. Hence, human subjects' approval was not necessary nor sought since this was a de-identified secondary data analysis only study.

Data analysis

We stratified the sample using a medical productivity index (MPI). The MPI we used was developed by Parente (Parente 2011, 2013). The MPI metric was devised to relate health and medical care effort spent on medical treatment to health outcomes (Parente 2013). A key design feature of the MPI is the use of common variables found in insurance claims data by all public and private insurers. Specifically, it requires only four data fields: patient ID (preferably encrypted), date of service,

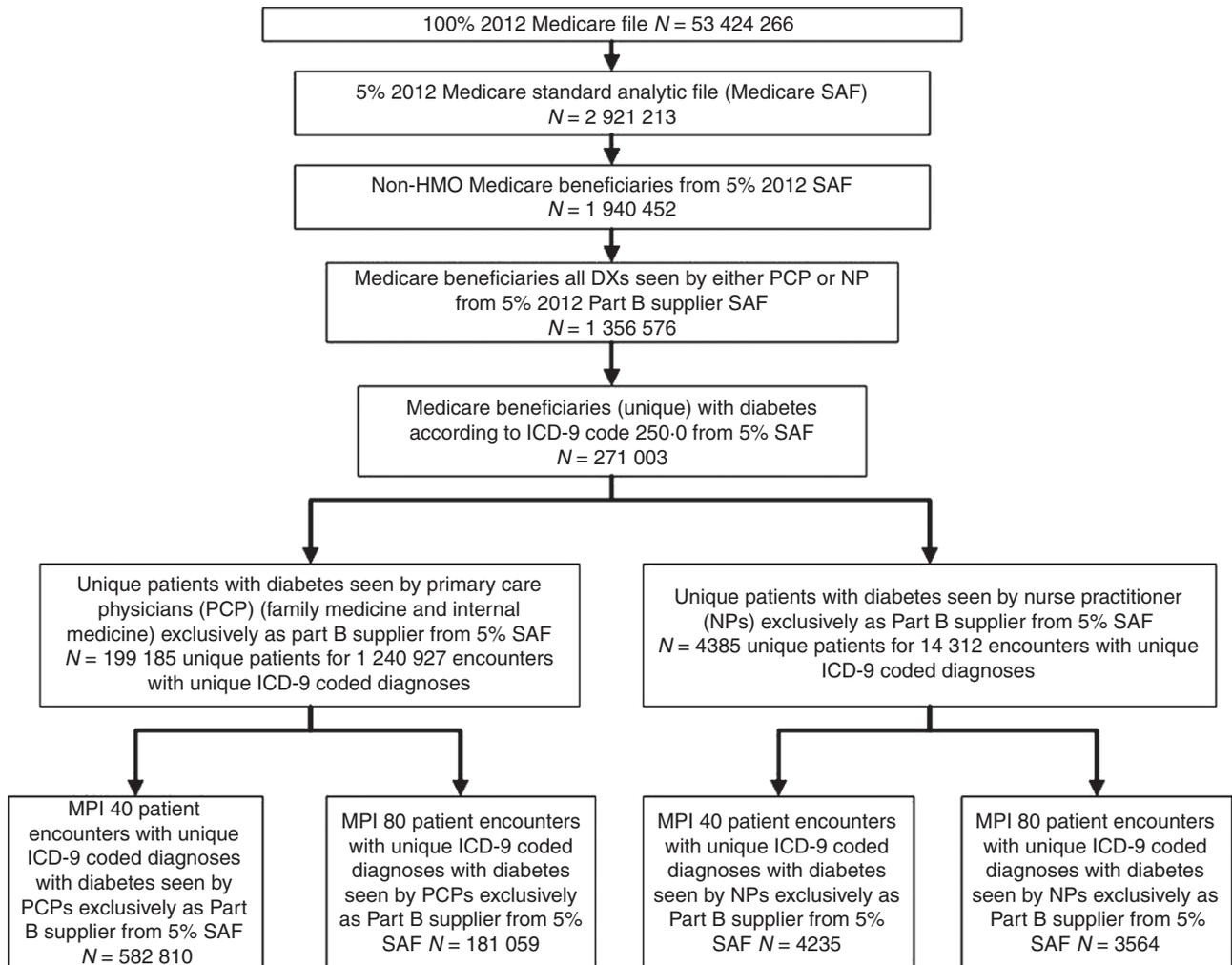


Figure 1 Flowchart depicting selection of patients for analysis from 2012 Medicare standard analytic file.

diagnosis code and procedure code. Another feature of the MPI is not requiring cost or payment information from the claim. Given the high variability in the ratio between provider charge and payment, the use of a simple set of non-cost variables permits the robust comparison of clinical input and output at the patient level without relying on negotiated provider price for service as a potential biased metric of resource consumption. For this study, the benefit of MPI was that one can focus on a specific patient population by disease or condition (in our case DM2). The MPI is an input–output ratio whereby input is health resource use and output is health status, the input is lagged by one quarter. Health (input) is defined using the Johns Hopkins Adjusted Clinical Group (ACG) system (Parente 2011, 2013), whereby we divide 1 by the count the number of health conditions an individual has recorded in his/her claims. If a person has no health conditions, the denominator of measuring health is the 75th percentile health value of the population. Health resource use is defined as the sum of Resource-Based Relative Value Scores associated with specific Current Protocol Terminology (CPT), which are a component of Healthcare Common Procedural Coding System (HCPCS) codes. If no resources are used, again, the 75th percentile resource value is used. If the MPI is close to 0/1, the person is in better/worse health.

We used the MPI as a categorical variable that represents different stratification of health in the study sample (Parente 2011, 2013). We defined two levels of the MPI that were calculated and applied in this study—MPI 40 and MPI 80. The MPI 40 represented 40% of the study population that was the least healthy (highest disease burden) and used the most resources (most provider time). The MPI 80 represented the healthiest 20% of the study population that had the least disease burden and used the least resources. The rationale for creating the categories of MPI 40 and MPI 80 was to create comparison groups consisting of the healthiest and the least healthy Medicare beneficiaries, in our case with DM2.

We further restricted the sample to those DM2 patients who had one of the 10 most common three-digit ICD-9 codes among all DM2 patients, by MPI category and by provider type (primary care physician or NP). All cases not in the top ten diagnostic categories were removed from the study population. We performed descriptive and statistical analyses within and between these various groups.

We focused on several health service outcome variables, healthcare cost (Medicare allowable payments) variables and patient health outcome variables per the availability in claims records. Our choice of outcome study variables were

similar to those used by other researchers (see Appendix S1) (Virnig *et al.* 2014).

Some of the analyses were performed using SAS version 9.3. SPSS version 23.0 (IBM, Chicago, IL, USA) was also used for some of the analyses. For all tests of statistical significance (*t*-test and *z*-test as indicated on the tables displaying statistical analysis), alpha was set at ≤ 0.05 .

Validity and reliability

An estimated 98% of adults over the age of 65 are Medicare enrollees, making Medicare data one of the most robust sources of utilization information in the USA. Moreover, with more than 45 million beneficiaries enrolled in the Medicare programme, detailed sub-group analysis with reduced concerns about loss of statistical power is possible. Furthermore, conducting research using Medicare claims data is cost-effective. These data allow access to claims information across multiple providers for a given beneficiary while providing a consistent reporting format. Nevertheless, conditions and/or diseases must be diagnosed to appear in the utilization data files. In addition, with these data as well as all medical records data, some common diseases such as hypertension, depression and DM2 are often under-diagnosed. Finally, while the files provide a reliable record of the care received by the beneficiary, they do not provide information on the care needed.

Results

In Table 1, we show the top 10 unique ICD-9 coded diagnoses from encounters (most common by per cent calculation) for Medicare patients with DM2 seen by primary care physicians exclusively by MPI status (all patient encounters, MPI 40 and MPI 80 patient encounters). These data are descriptive, no statistical tests were performed. The top 10 most frequent diagnoses for the categories of all patient encounters and MPI 40 patient encounters were the same with some differences in the rank order by per cent (e.g., for all patients the diagnostic category of *Factors Influencing Health Status and Contact with Health Services* had the highest per cent ranking for the all patients status but was ranked second for the MPI 40 patients). Eight of the ICD-9 three-digit diagnostic categories were shared by the all three MPI status groups – MPI 40, MPI 80 and all patients. Again, there was some variation in the rank ordering of the per cent by diagnosis. The two diagnostic categories that were unique to the MPI 80 group were: 790-796 – Non-specific Abnormal Findings; and 240-246 – Disorders of the Thyroid Gland.

Table 1 Top 1 Diagnoses* By MPI status for patients with diabetes seen exclusively by primary care physician 2012 five per cent Medicare data file.

3 digit ICD-9 code	% All patients (<i>n</i> = 1,240,927) (% rank order)	% MPI 40 [†] patients (<i>n</i> = 582,810) (% rank order)	% MPI 80 [‡] patients (<i>n</i> = 181,059) (% rank order)
Factors influencing health status and contact with health services	(1) 13.64	(2) 10.86	(1) 18.43
401-405 hypertensive disease	(2) 12.17	(3) 9.64	(2) 17.75
780-789 symptoms	(3) 11.50	(1) 13.55	(5) 7.67
249-259 diseases of other endocrine glands	(4) 10.20	(4) 8.51	(3) 13.67
270-279 other metabolic disorders and immunity disorders	(5) 5.86	(5) 4.79	(4) 7.97
710-719 arthropathies and related disorders	(6) 3.54	(6) 3.85	(7) 2.68
420-429 other forms of heart disease	(7) 2.95	(7) 3.73	
460-466 acute respiratory infections	(8) 2.94	(9) 2.78	(6) 2.76
720-724 dorsopathies	(9) 2.48	(8) 2.91	(10) 1.56
490-496 chronic obstructive pulmonary disease and allied conditions	(10) 2.01	(10) 2.33	
790-796 nonspecific abnormal findings			(8) 1.78
240-246 disorders of thyroid gland			(9) 1.68
Per cent of all diagnoses By MPI status	67.29	62.95	75.95

*These are the top ten diagnoses by each MPI category.

[†]MPI 40 represents the least healthy patients.

[‡]MPI 80 represents the most healthy patients.

MPI, medical productivity index.

Table 2 displays the top 10 diagnoses (most common by per cent calculation) for Medicare patient encounters with DM2 seen by NPs exclusively by MPI status (all patient encounters, MPI 40 and MPI 80 patient encounters). Similar to the patterns emergent with the primary care physician data, there was considerable consistency with the types of diagnoses (although not rank order) across patient groups. For NPs, nine diagnoses were shared across the three groups of patients. The MPI 40 and MPI 80 patients both did not have the diagnosis 700-709 – Other diseases of Skin and Subcutaneous Tissue in the top 10 diagnoses for Medicare patients with DM2 encounters. One difference is that, for the MPI 40 patient encounters, the diagnostic category of 420-429 – Other Forms of Heart Disease (with a rank order of nine) was included as one of the top ten diagnoses. The diagnostic category (with a rank order of 10) 380-389 Diseases of the Ear and Mastoid Process occurred in the top 10 diagnoses of MPI 80 patient encounters only.

When comparing the data displayed in Tables 1 and 2 (representing patients seen exclusively by primary care physicians and exclusively by NPs respectively), there were many more similarities than differences. For instance, seven of the 10 diagnostic categories are shared by both provider groups. The primary care physician group did not have the following three diagnostic categories that the NP group had: 590-599 Other Diseases of Urinary System; 700-709 Other Diseases of Skin and Subcutaneous Tissue; and 380-389 Diseases of the Ear and Mastoid Process. The NP

group did not have the following three diagnostic categories that the primary care physician group had: 490-496 – Chronic Obstructive Pulmonary Disease and Allied Conditions; 790-796 Nonspecific Abnormal Findings; and 240-246 Disorders of Thyroid Gland.

Table 3 displays the comparison of health services, health and healthcare cost outcomes for MPI 40 DM2 patient encounters with at least one of the top 10 diagnoses seen exclusively by either a primary care physician only (no other recorded healthcare provider) or a NP only (no other recorded healthcare provider). Statistically significant differences (by *t*-test) were detected for the health services outcome variables inpatient admissions, number of inpatient days and number of provider visits. The two health outcome variables that were significantly different were eye exams ordered and flu shots provided. Six healthcare cost outcome variables were also examined and the per cent differences in per patient average annual cost calculated. The range for per cent cost differences per patient between primary care physician and NPs for the variables involved was 8.32-120.05%. The lowest per cent difference calculated was for the variable outpatient costs. This was the only variable where NP costs were higher than physician costs. The highest per cent difference was for inpatient costs. Statistical significance for the healthcare cost differences were detected for four healthcare cost outcome variables and these are denoted on Table 3 (the test statistic for these analyses was a *z*-test).

Table 2 Top 10 diagnoses* by MPI status for patients with diabetes seen exclusively by nurse practitioners 2012 five per cent Medicare data file.

3 Digit ICD-9 Code	% All patients (<i>n</i> = 14,312) (% rank order)	% MPI 40 [†] patients (<i>n</i> = 4235) (% rank order)	% MPI 80 [‡] patients (<i>n</i> = 3564) (% rank order)
249-259 diseases of other endocrine glands	(1) 13.55	(3) 9.23	(1) 19.30
401-405 hypertensive disease	(2) 13.53	(2) 9.59	(2) 18.49
Factors influencing health status and contact with health services	(3) 11.64	(4) 8.67	(3) 14.96
780-789 symptoms	(4) 9.74	(1) 12.99	(5) 5.89
270-279 other metabolic disorders and immunity disorders	(5) 5.25	(6) 3.75	(4) 6.62
460-466 acute respiratory infections	(6) 3.67	(7) 3.40	(6) 3.56
710-719 arthropathies and related disorders	(7) 3.13	(5) 3.83	(7) 2.08
720-724 dorsopathies	(8) 2.44	(8) 3.12	(8) 1.77
590-599 other diseases of urinary system	(9) 2.21	(10) 2.46	(9) 1.68
700-709 other diseases of skin and subcutaneous tissue	(10) 1.87		
420-429 other forms of heart disease		(9) 2.76	
380-389 diseases of the ear and mastoid process			(10) 1.43
Per cent of all diagnoses by MPI status	67.03	59.8	75.78

*These are the top ten diagnoses by each MPI category.

[†]MPI 40 represents the least healthy patients.

[‡]MPI 80 represents the most healthy patients.

MPI, medical productivity index.

Table 4 displays the comparison of health services, health and healthcare cost outcomes for MPI 80 DM2 patients with at least one of the top 10 diagnoses exclusively seen by either a primary care physician (no other recorded healthcare provider) or exclusively by an NP (no other recorded healthcare provider). Statistically significant differences were detected for the health services variable number of provider visits. No significant differences were detected for the six health outcomes examined and compared. For healthcare cost outcomes, the range for per cent cost differences per patient between primary care physician and NP ranged from 5.58-105.14%. The lowest per cent difference calculated was for the variable outpatient costs. The highest per cent difference was for inpatient costs. Statistical significance for the healthcare cost differences were detected for three cost variables and these are denoted on Table 4 (the test statistic for these analyses was a *z*-test).

Table 5 displays the comparison of health services, health and healthcare cost outcomes for all DM2 patients, regardless of MPI status, with at least one of the top ten diagnoses seen exclusively by either a primary care physician or exclusively by an NP. Using a *t*-test statistically significant differences were detected for the health services outcome variables inpatient admissions, number of inpatient days and number of provider visits. For the health outcome variables, eye exams ordered and flu shots provided statistically significant differences were also found. In each of these instances, the data favored NPs. For healthcare costs

outcome variables, the range for per cent cost differences per patient between primary care physician and NPs for the variables involved was 26.31% for outpatient costs to 138.23% for inpatient costs. All of the per cent differences calculated for the six cost variables favored NPs. Statistical significance for the cost differences were detected for five of the six healthcare cost outcome variables and these are denoted on Table 5. A *z*-test was used to calculate statistically significant differences in the healthcare costs outcome variables analysed.

Discussion

This study sought to answer the overall question: Does primary care DM2 management for Medicare patients differ by provider type (physician or NP)? We had four key findings: (1) patient case-mix, using ICD-9 codes diagnoses, was similar across MPI categories and provider type; (2) health services utilization variables were significantly different by MPI categories and provider type; (3) patient health outcomes were at times similar and significantly different by MPI categories and provider type; and (4) healthcare costs were significantly different by MPI categories and provider type.

This study makes an important contribution since despite positive patient outcome data attributed to care received by nurse practitioners, there continue to be many states in the USA and other developed countries that maintain

Table 3 Comparison of health services, health and healthcare cost outcomes for MPI 40[†] diabetes patients with top 10 diagnoses seen by primary care physicians exclusively vs. nurse practitioners exclusively 2012 five per cent Medicare file.

Outcome variables	Frequency MPI 40		Average per patient MPI 40		P value (for <i>t</i> -test)
	PCP only (<i>n</i> = 28,150)	NP only (<i>n</i> = 365)	PCP only	NP only	
Health services outcomes					
Inpatient mortality	305	–	0.011	–	–
Inpatient admissions	22,739	59	0.808	0.162	0.01*
Number of inpatient days	124,649	241	4.428	0.660	0.01*
Average length of stay	5.48	4.08	–	–	–
Number of provider visits	209,062	1,590	7.427	4.356	0.01*
Health outcomes					
Lower extremity amputation	79	–	0.003	–	–
HbA1c	19,321	262	0.686	0.718	0.63
Eye exams	1,508	10	0.054	0.027	0.02*
Lipid screens	14,365	181	0.510	0.496	0.78
Flu shots	3,307	75	0.117	0.205	0.01*
Foot ulcers (number of patients)*	358	6	0.013	0.016	0.58
Healthcare cost outcomes					
Outcome variables	Overall cost MPI 40		Average cost per patient MPI 40		Per cent difference for per patient average annual cost (<i>z</i> -test for significance)
	PCP only	NP only	PCP only	NP only	
Part B (provider) \$	\$240,586,558	\$2,113,223	\$8,546.59	\$5,789.65	38.47*
Inpatient \$	\$1,096,067,187	\$3,550,307	\$38,936.67	\$9,726.87	120.05*
Outpatient \$	\$1,364,549,981	\$19,230,510	\$48,474.24	\$52,686.33	8.32
Home health \$	\$47,857,880	\$324,502	\$1,700.10	\$889.05	62.64*
Skilled nursing facility \$	\$80,311,497	\$641,961	\$2,852.98	\$1,758.80	47.46
Total \$	\$2,829,373,103	\$25,860,503	\$100,510.59	\$70,850.69	34.61*

*Statistically significant differences with alpha <0.05.

[†]MPI 40 represents the least healthy patients.

restrictions on nurse practitioner licenses suggesting that there is a need for more research examining health outcomes and costs, where nurse practitioners are concerned. Moreover, this study used the MPI to stratify Medicare DM2 patients into meaningful strata of least and most healthy for comparisons. Other studies have not done this.

When comparing the healthiest (MPI 80) Medicare patients with DM2 to the least health (MPI 40) by top 10 diagnoses (% of all diagnoses other than DM2) by provider type (primary care physician or NP) many more similarities than differences emerged. This pattern also emerged from the all patient data (no MPI stratifiers) by the two different provider types. These findings suggest that in 2012 primary care physicians and NPs provided primary care for similar Medicare patients with DM2. More to the point, NPs were not providing care to only the healthiest patients while primary care physicians provided care to the least healthy. Our findings were similar to earlier research looking at

differences in patients seen by physicians and other providers in primary care settings using other data sources (Everett *et al.* 2009, Morgan *et al.* 2012). One study (Morgan *et al.* 2012) analysing 5 years of Veterans Health Administration data found that NPs and physician assistants (PAs) provided 25% of primary care visits and that these visits were similar regarding patient and encounter characteristics to those of physicians. A state specific study (Everett *et al.* 2009) found that the population served by PAs and NPs in contrast to physicians differed demographically but not in complexity. In difference to these studies, ours was focused on a specific population – Medicare beneficiaries – and disease state – DM2. In our study, we did not look at PAs due to sample size considerations since there is a low prevalence of PAs working in primary care settings.

Findings from our study also revealed statistically significant differences in the health services utilization of patients stratified by MPI status and seen by each provider type for

Table 4 Comparison of health services, health and healthcare cost outcomes for MPI 80[†] diabetes patients with top 10 diagnoses seen by primary care physicians exclusively vs. nurse practitioners exclusively 2012 five per cent Medicare file.

Outcome variables	Utility and cost MP80		Average per patient MP80		P value (for t-test)
	PCP only (n = 17,014)	NP only (n = 504)	PCP only	NP only	
Health services outcomes					
Inpatient mortality	24	–	0.001	–	–
Inpatient admissions	1,521	11	0.089	0.022	0.88
Number of inpatient days	6,567	60	0.386	0.119	0.71
Average length of stay	4.32	5.45	–	–	–
Number of provider visits	68,550	1,477	4.029	2.931	0.01*
Health outcomes					
Lower extremity amputation	9	–	0.001	–	–
HbA1c	11,114	347	0.653	0.688	0.48
Eye exams	234	10	0.014	0.020	0.43
Lipid screens	7,625	243	0.448	0.482	0.39
Flu shots	829	37	0.049	0.073	0.07
Foot ulcers (number of patients)*	24	–	0.001	–	–

Outcome variables	Overall cost MPI 80		Average cost per patient MPI 80		Per cent difference for per patient average annual cost (z-test for significance)
	PCP only	NP only	PCP only	NP only	
Healthcare cost outcomes					
Part B (provider) \$	\$24,299,179	\$508,326	\$1,428.19	\$1,008.58	34.48*
Inpatient \$	\$54,516,269	\$502,163	\$3,204.20	\$996.36	105.14
Outpatient \$	\$52,948,101	\$1,483,375	\$3,112.03	\$2,943.20	5.58
Home health \$	\$5,721,535	\$87,374	\$336.28	\$173.36	64.04
Skilled nursing facility \$	\$4,971,222	\$1,626	\$292.18	\$3.23	188.03*
Total \$	\$142,456,306	\$2,582,864	\$8,372.89	\$5,124.73	48.13*

*Statistically significant differences with alpha <0.05.

†MPI 80 represents the most healthy patients.

some, although not all of the health services variables examined. Differences were detected in some of the health services utilization variables for both MPI levels (40 and 80) and all beneficiaries with DM2 regardless of MPI status. For the least healthy Medicare beneficiaries with DM2, when statistical significance could be calculated, findings favored NPs. Average inpatient admissions, average number of inpatient days and average number of provider visits were all less for patients seen by NPs in comparison to physicians. An earlier study (Everett *et al.* 2009) comparing healthcare utilization of patients seen in primary care settings by physicians found that patients seen by PAs and NPs had few differences in healthcare utilization, though the study had several limitations including a patient mean age of 64 years (hence a sample with more young patients than the one we examined), being focused on a single US state and relying on self-report data alone (rather than clinical data).

As noted, for a few of the health outcome variables there were some statistically significant differences detected, although for most no significant differences were detected suggesting that outcomes for care differs little between NPs and primary care physicians. Other studies have yielded similar results (Mundinger *et al.* 2000, Lenz *et al.* 2004, Eibner *et al.* 2009, Naylor & Kurtzman 2010, Newhouse *et al.* 2011, Oliver *et al.* 2014, Martin-Misener *et al.* 2015). For instance, a recent review piece (Newhouse *et al.* 2011) demonstrated that when comparing patient healthcare outcomes for care provided by NPs or MDs, equivalent rates were observed for almost all of the comparisons. Also supporting the equivalency of NP and primary care physician healthcare outcomes, a 2-year follow-up study examining primary care outcomes in patients treated by NPs or physicians (Lenz *et al.* 2004) found few outcome differences. A 2015 systematic review (Martin-Misener *et al.* 2015) yielded similar findings regarding the

Table 5 Comparison of health services, health and healthcare cost outcomes for all diabetes patients with top 10 diagnoses seen by primary care physicians exclusively vs. nurse practitioners exclusively 2012 five per cent Medicare file.

Outcome variables	Total utility and cost		Average per patient		P value (for <i>t</i> -test)
	PCP only (<i>n</i> = 78030)	NP only (<i>n</i> = 1536)	PCP only	NP only	
Health services outcomes					
Inpatient mortality	430	–	0.006	–	–
Inpatient admissions	30,710	102	0.394	0.066	0.01*
Number of inpatient days	160,250	439	2.054	0.286	0.01*
Average length of stay	5.22	4.3	–	–	–
Number of provider visits	448,199	5,652	5.744	3.680	0.01*
Health outcomes					
Lower extremity amputation	112	1	0.001	0.001	0.24
HbA1c	52,796	1,054	0.677	0.686	0.75
Eye exams	2,575	33	0.033	0.021	0.01*
Lipid screens	38,251	754	0.490	0.491	0.97
Flu shots	6,116	174	0.078	0.113	0.01*
Foot ulcers (number of patients)	497	9	0.006	0.006	0.47

Outcome variables	Overall cost		Average cost per patient		Per cent difference for per patient average annual cost (<i>z</i> -test for significance)
	PCP only	NP only	PCP only	NP only	
Healthcare cost outcomes					
Part B (provider) \$	\$364,400,253	\$4,259,941	\$4,670.00	\$ 2,773.40	50.97*
Inpatient \$	\$1,399,716,968	\$5,032,875	\$17,938.19	\$3,276.61	138.23*
Outpatient \$	\$1,719,920,614	\$25,983,433	\$22,041.79	\$16,916.30	26.31*
Home health \$	\$73,722,310	\$701,959	\$944.79	\$457.00	69.61*
Skilled nursing facility \$	\$108,279,539	\$1,522,324	\$1,387.67	\$991.10	33.30
Total \$	\$3,666,039,684	\$37,500,532	\$46,982.44	\$24,414.41	63.95*

*Statistically significant differences with alpha <0.05.

equivalency of or better health outcomes for patients seen by NPs in contrast to primary care physicians.

With a single exception (outpatient costs for MPI 80 patients), healthcare costs were lower for care provided by NPs than primary care physicians. The per cent differences in all but one of the healthcare cost variables favored NPs as did all of the cost differences that were statistically significant. Moreover, for all three groups of patients (MPI40, MPI 80 and all patients) the average per patient total cost of health care was lower for NP seen patients and these differences were statistically significant. Other studies (Oliver *et al.* 2014) and review papers (Martin-Misener *et al.* 2015) have hinted at the cost-effectiveness of health care provided by NPs while others (Morgan *et al.* 2012) have called for research comparing costs associated with care provided by different provider types (Newhouse *et al.* 2011, Martin-Misener *et al.* 2015).

While, as two different studies have noted, (Eibner *et al.* 2009, Martin-Misener *et al.* 2015) research based on insurance claims data have yielded findings of cost-effectiveness of NP provided care, the discomfort with such studies is that the cost-effectiveness might be based solely on the

substitution of NPs (whose labour costs less) for primary care physicians (whose labour costs more). If cost-savings are attributable to a substitution factor alone, as suggested by at least one study, (Eibner *et al.* 2009) then this potentially speaks to an element of workforce exploitation. Healthcare cost-savings could be capitalized on, as some have suggested (Emanuel *et al.* 2012, Ghorob & Bodenheimer 2012, Bodenheimer & Smith 2013, Green *et al.* 2013, Iglehart 2013) by making concerted efforts to develop and provide team-based primary care that allows NPs to work at the top of their license in primary care. Compensating providers for care provision in an equitable manner will require the careful and thoughtful consideration of many different stakeholders.

Limitations

There are a few limitations to this study. First, only 5% sample of Medicare patients were examined rather than the entirety of the Medicare population. Regardless, 5% sample is substantial and there is precedent for its use in research. Second, the inclusion criteria, while necessary to reduce

confounding, also reduced the number of patients seen by NPs only. Similarly, claims data are limited in its ability to capture the billing activity of NPs in states with restricted NP scope of practice. NPs billing under a physician partner's license would not be identified even if a patient saw the NP only for their care. Nevertheless, the patient numbers provided a sufficient sample to detect statistically significant differences. Third, there was no way to examine or control for the influence, if any, of selection choices for a specific provider type (primary care physician or NP) by patients. Fourth, analyses were limited to Medicare beneficiaries with DM2. This decision was made for sound reasons including defining the population in a meaningful way, nonetheless, doing so reduced the sample size. Finally, the 5% Medicare claims data do not include patient demographic information. While such information would provide a more nuanced and richer picture of the patient population, this would not change the findings of the research reported on here. We do believe that future research should include patient demographic data in their analyses if at all possible.

Conclusions

Our results, suggest nurse practitioner engagement in chronic care patient management is associated with lower cost and better quality care. Overall, the findings from the study reported on here inform the current healthcare workforce conversations regarding healthcare quality, healthcare outcomes and healthcare costs as these relate to NPs and/or primary care physicians. The conversation streams on these issues are complex and timely when contextualized by healthcare reform efforts in the USA as spearheaded by the ACA (Hofer *et al.* 2011). This research might also provide direction and influence similar conversations taking place in other developed countries such as the UK, Canada and the Netherlands.

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Conflict of interest

No conflict of interest has been declared by the authors.

Author contributions

All authors have agreed on the final version and meet at least one of the following criteria [recommended by the ICMJE (<http://www.icmje.org/recommendations/>)]:

- substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site.

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