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Determinants of primary care physicians' referral pattern: a structural equation model approach

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Abstract

This study examines patient referrals by primary care physicians (PCP) with nurse practitioners and physician assistants (NP-PA) in their medical practices as compared to practices without them. The study uses data from the Robert Wood Johnson Foundation community tracking study (CTS) Physician Survey, Round I (1996–97) and II (1998–99). Structural equations with binary dependent variables were used to examine the links among managed care, the use of NP-PA, the complexity of patient's conditions, and the number of referrals. PCP's with NP-PA were found to have a greater likelihood of treating patients with complex conditions instead of referring them to specialists. Managed care related variables (i.e., large group practice/HMO, the percentage of patients for whom PCPs acted as gatekeepers, and the percentage of managed care revenue from capitated/prepaid contracts) affected PCP' patient referrals, but only through the increased use of NP-PA. PCP's with NP-PA were also found to provide appropriate care to the complex patients. These findings indicate that NP-PA enable PCP to concentrate on patients with more complex conditions thus reducing the number of referrals. In addition, NP-PA is found to affect the gatekeeper role of PCPs.

Keywords

physician referral; nurse practitioner; physician assistant; managed care

1 Introduction

The growth of managed care in the late 1980s and early 1990s greatly increased the use of nurse practitioners and physician assistants (NP-PA) as primary care practitioners (Hooker and Berlin, 2002; Hooker, 2006). The estimated number of NPs increased by almost 500% from 23,659 in 1992 to 141,209 in 2004, (Health Resources and Services Administration, 2002) while PAs in clinical practice increased by 268% from 20,448 in 1991 to 75,260 in 2007 (American Academy of Physician Assistants, 2000, 2007). The use of NP-PA in medical practices increased productivity (Wozniak, 1995). They enabled the practices to treat more patients at a lower cost (Roblin et al., 2004); the salaries of NP-PA are substantially less than those of primary care physicians (PCP). Further, NP-PA appeared to provide similar quality of medical care to that of physicians (Mundinger et al., 2000).

Because they are increasingly being employed, it is important to investigate what impacts NP-PA are having upon the patients they treat, the medical practices they work in, and the physicians they work with (Cooper, 2001; Huang et al., 2004; Bodenheimer et al., 2002; Safran, 2003; Institute of Medicine, 2001). As part of this effort, this study examines the possible impacts NP-PA are having upon the referral of patients. Specifically, it examines the referrals by PCP with NP-PA in their medical practices as compared to practices without them.

Several researchers have speculated about the possible impacts, NP-PA may have upon PCP' patient referrals to specialists. According to DeAngelis (1994, p.869), PCP who do not have NP-PA in their practices are more likely to refer patients with complicated conditions, because of the cost and time constraints they pose. She writes:

“... if a generalist physician must spend one hour or more evaluating and treating one patient, he or she would be unable to meet the needs of the other three or four patients who could have been seen in that time. Also, with current reimbursement to generalists, spending that much time with one patient on a recurrent basis would not be financially feasible.”

DeAngelis (1994) suggests that using NP might solve this problem. They could be used to effectively care for those patients who require health maintenance, health education, or who have minor illnesses. Thus, they would free the physicians to treat the more seriously ill or medically complicated patients. As a result, PCP might personally manage many of the patients they previously referred to specialists.

Anecdotal evidence and an empirical study tend to lend support to DeAngelis' (1994) view. Interviews of a sample of NP-PA, PCP, and healthcare administrators conducted by Jacobson et al. (1998) revealed that NP-PA appear to be freeing physicians from some routine primary care tasks (i.e., well-baby care, and treating minor infections) thus enabling them to concentrate on caring for the sickest patients. And in an analysis of the National Ambulatory Medical Care Surveys, Hooker and McCaig (2001) found that in medical practices with NP-PA the more complicated patients (i.e., older individuals who required more diagnostic tests) were more likely to be seen by PCP.

2 Conceptual framework

Figure 1 shows the conceptual framework and hypothesised relationships used in this study. The use of NP-PA is viewed as being causally linked to increases in treating patients with complex conditions. This, in turn, is linked to decreases in referrals to specialists. Managed care is viewed as having a critical effect upon each of these factors. Three components of managed care are identified that are known to distinguish PCP having NP-PA versus those practices without them. They include: a greater gatekeeper requirement, a higher capitation rate, and a large group practice/HMO settings as opposed to a traditional solo practice. While the first two components are hallmarks of managed care plans, managed care also tends to encourage the consolidation of solo/small group practices into larger ones (Dranove et al., 2002; Casalino et al., 2003).

3 Methods

3.1 Data sources

This study used data from the Robert Wood Johnson CTS Physician Survey, Round I (1996–1997) and II (1998–1999). To measure changes in the healthcare system, the survey collected self-reported data from practicing physicians in 60 randomly selected communities. It also collected data from a cross-sectional national sample of physicians. About 50% of the physicians in Round I of the sample were resample in Round II. (Potter et al., 2001) After

cleaning and editing the survey data, we obtained useable information on 5,190 PCP from Round I and 4,991 from Round II.

3.2 Variables

Variables used in our study are described in Table 1, along with the corresponding survey questions, and their descriptive statistics. The first dependent variable, NP-PA, was coded 1 if a PCP reported one or more NP-PA, and 0 if they reported 'none'. About half of the PCPs reported having a NP-PA in their medical practices. The second variable, complexity, was coded 1 if a PCP responded with 'increased a lot' or 'increased a little' to the question concerning the extent of change over the past two years in the complexity or severity of patient conditions they treated without referral to specialists. It was coded 0 if the PCP responded 'remained the same', 'decreased a little', or 'decreased a lot'. The third variable, referral, was reverse coded, that is one if a PCP responded 'decreased a lot' or 'decreased a little' to the question about the extent of change over the past two years in the number of referrals. And it was coded 0 for all other responses.

Three components of managed care were selected as ultimate determinants of our dependent variables: the percentage of patients a PCP served in a gatekeeper role, the percentage of the practice's patient revenue paid on a capitated or prepaid basis, and the organisational setting. Other individual and medical practice variables used in our study as control variables included: comparative practice profiling, the ability to refer to specialists of high quality when needed, case mix (% Medicare and % Medicaid revenue), experience (practice starting year), general primary care specialty (family practice/general medicine) and other relatively specialised primary care specialties (pediatrics, geriatric or internal medicine). All variables except Medicare and Medicaid were used as dummy variables.

3.3 Analytical methods

Our study assumes that categorical dependent variables enter the structural equation model only indirectly in the form of latent variables. With this restriction, a unified framework can be reached in which the categorical variables are incorporated as independent variables into the model so that the conventional structural equations remain intact.

To conduct our analysis, we used the Muthén's Mplus program (Muthén and Muthén, 2007). Utilising that program, we constructed a series of models. First, we constructed a measurement model relating our binary dependent variables y to the unobserved continuous variables y^* :

$$\begin{aligned} \text{NP} - \text{PA} &= 1 \text{ if } \text{NP} - \text{PA}^* > \alpha_1; \text{NP} - \text{PA} = 0 \text{ otherwise} \\ \text{Complexity} &= 1 \text{ if } \text{Complexity}^* > \alpha_2; \text{Complexity} = 0 \text{ otherwise} \\ \text{Referral} &= 1 \text{ if } \text{Referral}^* > \alpha_3; \text{Referral} = 0 \text{ otherwise} \end{aligned} \quad (1)$$

where the α 's are the threshold parameters used to transform y to y^* . To denote the unobserved variable, a star is placed next to the name of its corresponding observed variable. NP-PA* can be thought of as measuring the medical practice's latent tendency of utilising NP-PA.

Next, for the structural part, we estimated three probit regressions:

$$\text{NP} - \text{PA}^* = f_1 [\text{gatekeeper, capitation, organisational settings}] \quad (2)$$

$$\text{Complexity}^* = f_2 [\text{gatekeeper, capitation, organisational settings, NP - PA}^*, \text{other individual/practice characteristics}] \quad (3)$$

$$\text{Referral}^* = f_3 [\text{gatekeeper, capitation, organisational settings, NP - PA}^*, \text{complexity}^*, \text{other individual/practice characteristics}] \quad (4)$$

where only NP-PA*, complexity*, referral* (y*) and independent variables are used. NP-PA* appears as an independent variable in the complexity* model. And NP-PA* and complexity* appear as independent variables in the referral* model.

4 Results

4.1 Initial analysis

A simple probit regression was used to determine the bivariate relationship between each of the three dependent variables and the selected independent variables (Table 2). The probit coefficients revealed, in general, the expected signs and their significance levels were mostly consistent across the data collection periods. Higher % gatekeeper and capitation were positively related to the use of NP-PA, increased complexity and decreased referrals. Increased complexity was significantly related to decreased referrals. Organisational settings demonstrated a significant influence on all of the dependent variables. However, its influence varied across specific practice settings, dependent variables and data collection periods.

Since all of the managed care variables were found to be significantly related to NP-PA use, complexity, and referrals, the structural equation model was used to isolate the net effects of these variables controlling for managed care. In addition, to measure for possible collinearity, a correlation matrix of all continuous independent variables was produced and examined. When multicollinearity exists, it is difficult for one variable to vary while others are held constant, thus little information from a partial regression coefficient can be obtained. The correlations between all of the variables were found to be .30 or low indicating no serious problem with multicollinearity.

4.2 Structural equation model

Table 3 presents multiple fit indices for our model. Overall, the indices show that the model fits well according to the cut off guide values suggested in the literature. (Hu and Bentler, 1999) The model using Round I data fit slightly better than that using Round II data. Table 3 also shows R² the explained variance in the dependent variables. The managed care variables gatekeeper, capitation, and organisational settings taken together accounted for 32–35% of the variance in NP-PA use, respectively for the two data sets. The managed care variables, NP-PA use and the control variables taken together accounted for 7–8% of the variance in the increases in complexity, while the managed care variables, NP-PA use, complexity and the control variables accounted for 20–24% of the variance in the decreases of referral.

Table 4 presents the path coefficients of the structural equation model. The path coefficient for the continuous independent variables x (including y^* as an independent variable) represents the amount of standard deviation (s.d.) change in y for a s.d. change in x , whereas the value for the dummy x indicates the amount of s.d. change in y for a change from, say, solo to group practice.

As hypothesised, all managed care variables were found to be positively associated with NP-PA use. A comparison of the path coefficients reveals that capitation had a greater influence on NP-PA use than % gatekeeper. When compared to solo practice, PCP in all other settings, particularly large group practice/HMO, had significant impacts on NP-PA use.

Greater NP-PA use was positively associated with reported increased complexity. And increased complexity, in turn, was positively associated with decreased referrals. NP-PA use was also significantly associated with decreased referrals, but only for the Round I period. Taken together, these findings suggest that the positive effect of NP-PA use on decreased referrals was mainly exerted through its impact on complexity.

Among the managed care variables, only % gatekeeper was found to be significantly related to complexity, both directly and indirectly through NP-PA use. However, there was no direct effect of gatekeeper on decreased referrals. These findings suggest that the positive impact of the gatekeeper requirements on decreased referrals was mainly exerted via NP-PA use and complexity.

On the other hand, despite the previously identified significant relationship between capitation/organisation settings and complexity (Table 2), no significant effects were found between these variables using the structural equation model. Furthermore, there were no direct effects between each of these two independent variables and referrals, although there were negative direct effects between HMO/other settings and referrals, but only for the Round I period. It appears that these two variables indirectly affect complexity and referrals. That is, capitation affects complexity but only through increased NP-PA use; only then does complexity have a strong influence on referrals. Similarly, organisational settings appear to indirectly affect complexity and referrals through increasing the availability of NP-PA. In short, NP-PA use may be fully mediating their effects upon decreased referrals via complexity.

The signs of the effects of the control variables found to be significant appear to be reasonable. While the significance levels varied by data collection period and whether the given dependent variable was complexity or referral, the ability to obtain needed quality referrals was negatively associated with both increased complexity and decreased referrals. When compared to PCP in internal medicine, physicians in pediatrics were less likely to report increased complexity, while those in family/general specialties were less likely to report decreased referrals. This may reflect the fact that PCP in family/general specialties treat patients with a greater range of conditions than those in internal medicine. PCP's who reported a large impact of comparative profiling on their medical practices were also more likely to report increased complexity and decreased referrals. Lastly, the variable practice starting year was negatively associated with increased complexity and decreased referrals. It appears that the indirect effect of practice starting year via complexity reinforced its direct effect on decreased referrals. That is, physicians with more experience tended to make fewer referrals.

4.3 Sensitivity analysis

We conducted a sensitivity analysis of our models to assess whether our findings were robust. Specifically, we replicated the structural equation model focusing on those PCP who reported 'increase a lot' and 'increase a little' to the question on the change in the number of referrals. We found that while the directions of the effects reversed, the magnitude and significance of the major results were very similar to those presented in Table 4.

We also conducted an ordered sequential analysis to see whether our findings were robust using different model specifications. First, we used the same structural equation model in Table 4 but without any control variables. The results remained unchanged. Next, we used the same model in Table 4 but with only capitation, excluding % gatekeeper and organisational setting

dummies. The results again were unchanged. That is, capitation was positively related only to NP-PA use, not to complexity and referrals. Then we added % gatekeeper and the directions and significance of effects were not different from those in Table 4.

4.4 Subsequent analysis

Our analysis indicates that PCP with NP-PA have a greater likelihood of treating patients with more complex conditions and a decreased likelihood of referring those patients to specialists. This finding was consistent even after controlling for the effect of the gatekeeper role.

These findings raise important healthcare policy issues. One key question is whether it is appropriate for PCP to treat these complex patients or not. To address this question, we constructed an additional probit model. It was specified as:

$$\text{Inappropriateness of complexity} = f_4 [\text{NP} - \text{PA use}, \% \text{ gatekeeper}, \text{NP} - \text{PA} * \% \text{ gatekeeper}] \quad (5)$$

where the variable NP-PA*% gatekeeper (NP-PA multiplied by % gatekeeper variable) tests the role of NP-PA use in moderating the gatekeeper effect. Capitation and organisational settings were excluded from the model because they were previously found to be indirectly associated with complexity via the use of NP-PA.

Table 5 shows the results of the model. As expected, PCP with a greater gatekeeper role reported more inappropriate care given to complex patients who were not referred to specialists. Despite an increase in complexity, having NP-PA had no significant effect upon reporting inappropriate care. Most importantly, NP-PA use moderated the effect of the gatekeeper role on inappropriateness of complexity without referrals. PCP with greater gatekeeper roles who had NP-PA were less likely to report inappropriateness than those without NP-PA. However, the magnitude of this moderation effect declined over the two data collection periods.

5 Conclusions

This study confirms that PCP's with NP-PA were more likely to treat patients with complex conditions and not refer them to specialists. It also found that PCP's with NP-PA appear to be treating these patients appropriately. The concerns about gatekeeper requirements that were found to be related to both increases in the number of patients with complex conditions and the provision of inappropriate care appeared to be reduced when PCP work with NP-PA. This study showed that NP-PA provided a significant and positive role in shaping PCP medical practices in a managed care environment. These findings have implications for healthcare policy makers because NP-PA will likely be increasingly employed in primary care practices in the future (Cooper, 2007).

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Figure 1.
Conceptual framework

Table 1

Definition of variables and descriptive sample statistics

Variable	Definition	Mean		Standard deviation	
		I #	II #	I	II
Dependent variables					
NP-PA use	Have NP-PA in practice	0.49	0.51	0.50	0.50
Increase in complexity	Extent of change over the past two years in the complexity of patients' conditions for which PCP provide care without referral to specialists	0.31	0.31	0.46	0.46
Decrease in referral	Extent of change over the past two years in the number of patients that PCP refer to specialists	0.20	0.14	0.40	0.35
Analytic independent variables					
Gatekeeper	% patients PCP serve in gatekeeper role	42.56	45.37	31.06	30.69
Capitation	% practice's managed care revenue which is capitated or prepaid	47.16	47.83	40.14	39.72
Organisational setting					
Solo	Solo/two physician practice	0.49	0.49	0.50	0.50
Large group	Group practice with physicians 3–9	0.14	0.16	0.35	0.36
Small group	Group practice with physicians 10+	0.20	0.18	0.40	0.38
HMO	Staff/closed group model HMO	0.12	0.11	0.32	0.31
Other	(Free-standing clinic, independent contractor, and owner physicians who don't fall into any of the other categories)	0.06	0.06	0.23	0.24
Control variables					
Comparative profiling	Impact of a comparison report based on things like referrals to specialists, hospitalisations or other measures of cost-effectiveness.	0.11	0.11	0.31	0.31
Owner	Practice ownership	0.71	0.68	0.45	0.46
Multiple practices	More than one practice	0.07	0.07	0.25	0.26
Foreign graduate	Graduates from foreign medical schools	0.23	0.26	0.42	0.44
Quality referral	Ability to obtain referrals to specialists of high quality when a PCP thinks it is medically necessary	0.82	0.78	0.39	0.42
% Medicare	% practice revenue from Medicare	27.78	27.89	23.00	23.01
% Medicaid	% practice revenue from Medicaid	13.03	13.42	16.43	16.38
Control variables					
Specialty					
Family/general		0.44	0.42	0.50	0.49
Internal medicine		0.33	0.33	0.47	0.47

Variable	Definition	Mean		Standard deviation	
		I #	II #	I	II
Pediatrics		0.23	0.24	0.42	0.43
Medical sub		0.01	0.01	0.08	0.08
Practice starting year					
< = 1960		0.07	0.05	0.26	0.22
< = 1970		0.13	0.10	0.33	0.29
< = 1980		0.25	0.23	0.43	0.42
< = 1990		0.39	0.36	0.49	0.48
> 1990		0.17	0.26	0.37	0.44

Notes: Data collection years; Round I (1996–1997); Round II (1998–1999).

Table 2

Probit coefficients from simple probit regressions

Independent variable	Dependent variables							
	NP-PA		Complexity		Referral			
	96-97	98-99	96-97	98-99	96-97	98-99	96-97	98-99
<i>NP-PA</i>			0.179**	0.196**	0.155**	0.144**		
Complexity					0.763***	0.671***		
% Gatekeeper	0.008**	0.007**	0.004**	0.004**	0.004**	0.004**		
% Capitation	0.007**	0.007**	0.001**	0.003**	0.002**	0.003**		
Organisational setting								
Large group	1.560***	1.755***	0.039	0.149**	0.034	0.167**		
HMO	1.871***	1.909***	0.247**	0.290**	0.043	0.179**		
Small group	0.532**	0.638**	0.012	-0.007	0.075	0.059		
Other	1.454***	1.591***	0.315**	0.168*	0.037	-0.026		

* Notes: Statistically significant at the .05 level;

** Statistically significant at the .01 level;

*** Statistically significant at the .001 level.

Table 3

Model fit indices and R²

Data years	Model fit indices						R ²		
	χ^2	df	CFI	TLI	RMSEA	WRMR	NP-PA	Complexity	Referral
1996–1997	42	10	0.98	0.89	0.025	0.95	0.32	0.07	0.24
1998–1999	82	11	0.85	0.76	0.036	1.26	0.35	0.08	0.20

Notes: Comparative fit index (CFI); Tucker-Lewis index (TLI); root mean square of approximation (RMSEA); weighted root mean square residual (WRMR).

Table 4

Path coefficients from structural equation model #

Independent variable	Dependent variables					
	NP-PA		Complexity		Referral	
	96-97	98-99	96-97	98-99	96-97	98-99
NP-PA						
			0.08**	0.09**	0.06*	0.03
Complexity					0.41***	0.35***
% Gatekeeper	0.05**	0.05**	0.07**	0.07**	0.04	0.04
% Capitation	0.06**	0.09***	-0.02	0.03	0.03	0.04
Organisational setting						
Large group	1.19***	1.35***	-0.10	-0.02	0.00	0.03
HMO	1.28***	1.16***	0.04	0.07	-0.25**	-0.09
Small group	0.38***	0.44***	-0.03	-0.05	0.00	0.02
Other	1.03***	1.09***	0.13	0.04	-0.27**	-0.18
Comparative profiling			0.25***	0.18**	0.10	0.17*
Owner			0.01	0.03	0.01	-0.06
Multiple practices			0.05	0.03	0.09	0.02
Foreign graduate			-0.04	0.03	-0.01	0.05
Quality referral			-0.29***	-0.33***	-0.28***	-0.21**
% Medicare			0.04	0.04	-0.05*	-0.06*
% Medicaid			0.02	-0.01	-0.04	-0.02
Specialty						
Family/general			-0.03	-0.08	-0.11*	-0.16***
Pediatrics			-0.17**	-0.15*	0.03	0.01
Medical subspecialties			-0.05	0.05	0.16	0.02
Practice starting year						
<=1960			-0.52***	-0.45***	-0.47**	-0.21*
<=1970			-0.40***	-0.32***	-0.15*	-0.19*

Independent variable	Dependent variables					
	NP-PA		Complexity		Referral	
	96-97	98-99	96-97	98-99	96-97	98-99
<=1980			-0.31***	-0.33**	-0.09	-0.15*
<=1990			-0.14**	-0.17**	-0.10	-0.02

Notes: The path coefficient for the continuous x (including y* as an independent variable) represents the amount of standard deviation (s.d.) change in y for an s.d. change in x, whereas the value for the dummy x indicates the amount of s.d. change in y for a change from, say, solo to group practice.

- * Statistically significant at the .05 level;
- ** Statistically significant at the .01 level;
- *** Statistically significant at the .001 level.

Table 5

Ordered probit model for inappropriateness of complexity without referral

Variable	Coefficient			Standard Error			Wald chi-square		
	96-97	98-99		96-97	98-99		96-97	98-99	
NPP Use	0.047	0.004		0.057	0.062		0.68	0.01	
Gatekeeper	0.006***	0.006***		0.001	0.001		58.46	56.29	
Gatekeeper NPP use	-0.004**	-0.002*		0.001	0.001		14.73	3.77	

* Notes: Statistically significant at the .06 level;

** Statistically significant at the .001 level;

*** Statistically significant at the .0001 level.