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RESEARCH ARTICLE

Impact of Physician Assistant Care on Office Visit Resource Use in the United States

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Objective. To investigate whether the use of physician assistants (PAs) as providers for a substantive portion of a patient's office-based visits affects office visit resource use.
Data Source. Medical Expenditure Panel Survey (MEPS) Household Component data from 1996 to 2004.
Study Design. This retrospective cohort study compares the number of office-based visits per year between adults for whom PAs provided $\geq$ 30 percent of visits and adults cared for by physicians only.
Data Collection/Extraction Methods. The Agency for Healthcare Research and Quality collects MEPS data using methods designed to produce data representative of the U.S. noninstitutionalized civilian population. Negative binomial regression was used to compare the number of visits per year between persons with and without PA care, adjusted for demographic, geographic, and socioeconomic factors; insurance status; health status; and medical conditions.
Principal Findings. After case-mix adjustment, patients for whom PAs provided a substantive portion of care used about 16 percent fewer office-based visits per year than patients cared for by physicians only. This difference in the use of office-based visits was not offset by increased office visit resource use in other settings.
Conclusions. Results indicate that the inclusion of PAs in the U.S. provider mix does not affect overall office visit resource use.

Key Words. Health workforce, physician assistants, access/demand/utilization of services, MEPS

Background and Rationale

The physician assistant (PA) profession has grown dramatically in recent years, with the number of practicing PAs tripling from about 20,000 in 1991 to over 68,000 in 2008 (American Academy of Physician Assistants 2007). There

is currently about one PA for every 10 physicians in clinical practice, and soon this ratio is likely to tilt further toward PAs because there is one PA entering the U.S. workforce for every six physicians (National Center for Health Statistics 2005). PAs are providing a growing portion of office visits for medical care in the United States (Druss et al. 2003), and could buffer predicted physician shortages. How this change in the provider mix might impact overall use of medical services, however, is unknown. Does PA participation increase the effective supply of what have traditionally been physician services, or does it lead to provision of expanded or redundant services, thereby increasing per capita office visits per year?

Existing research suggests that, in the United States, participation in care by PAs and nurse practitioners (NPs) does not increase overall use of medical services, but this research is from limited settings and patient populations. Hooker evaluated the effect of provider type (PA or physician) on an episode of care for four acute uncomplicated problems in a managed area setting and found that PAs did not require more expenditures or more return visits to manage the episode of care (Hooker 2002). In a rare randomized trial comparing provider types, Mundinger et al. (2000) found similar outcomes and health resource use among a predominantly female and Hispanic population randomized to receive primary care from either a NP or a physician for 1 year. The extent to which findings from these studies generalize to other settings or to care for chronic or serious conditions is unknown. Our literature review found no national study investigating the effect of PA or NP use on longitudinal health resource use.

Several studies have focused on the production efficiency of PAs and NPs as measured by the number of office visits provided per unit time or per unit of labor cost, compared with physicians. These studies have generally found that PAs provide between 76 and 100 percent as many office visits as physicians per unit time (Record et al. 1980; Hooker 1993; Larson, Hart, and Ballweg 2001), and that the use of PAs can lower labor costs (Roblin et al. 2004) and increase efficiency (Medical Group Management Association 2006).

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This apparent high productivity might be misleading with respect to cost-effectiveness if the use of PAs leads to increased per person resource use. For example, it is possible that PAs may be employed to provide services that would otherwise not have been provided (complementary services) or that PAs may schedule more return visits than do physicians, thereby increasing total office visits per person. Although complementary services and additional follow-up visits could result in higher quality of care, they might not increase the overall productivity of the workforce, a pressing concern given predicted physician shortages (Association of American Medical Colleges 2006).

As health services researchers consider the impact of PAs and NPs on health care provision, it is relevant to ask whether these clinicians replace care that would otherwise be provided by a physician (substitution of services) or whether they provide care that would otherwise not have been provided (complementary care).

The substitution model is supported by Hooker's study of roles of PAs and NPs in managed care (Hooker 1993), by Gryzbicki's detailed analysis of task substitution in a single family practice/general medicine practice in Pennsylvania (Grzybicki et al. 2002), and by Mundinger's randomized trial of NP and physician care (Mundinger et al. 2000) In addition, research on staffing ratios in health maintenance organizations in the mid-1990s found an inverse relationship between the numbers of PAs and advanced practice nurses (APNs) employed and numbers of physicians employed per 100,000 enrolled (Dial et al. 1995). As the use of PAs and APNs increased, the use of physicians decreased, suggesting that the PAs and APNs were providing services that physicians would otherwise provide. Several studies reporting on the use of physician assistants to replace house staff in academic medical centers are based on the assumption that PAs replace physician services (Carzoli et al. 1994; Stoddard, Kindig, and Libby 1994; Schulman, Lucchese, and Sullivan 1995; Miller et al. 1998).

Other research lends support to the complementary care model. Laurant et al. (2004) found that random assignment of NPs to primary care practices in the Netherlands did not affect physician workload, concluding that "Nurses are not substitutes for doctors but provide a wider range of services than was available previously." A randomized trial in Britain showed that NPs scheduled return visits more frequently than physicians (Venning et al. 2000) and a systematic review relying heavily on European experience indicated that NPs provide longer consultations and make more investigations than do physicians (Horrocks, Anderson, and Salisbury 2002). Generalizing these results to PA practice in the United States is problematic because

practice patterns in the United States may differ from those in Europe, and because PA practice can vary in meaningful ways from that of NPs (Hooker and McCaig 2001).

The dichotomization of PA/NP services as either a substitute or complement for physician care is an oversimplification, and both patterns are likely to exist in practice. Physicians and PAs/NPs develop diverse practice arrangements based on personal preferences and practice needs. Some physicians may choose to hire PAs or NPs to provide preventive and counseling services that the physicians are unable to find the time to provide, leading to services that are intentionally complementary. Others may work out substitution practice arrangements in which PAs or NPs see the patients with the least complicated routine problems, while the physicians see the more complex patients. In other practices, the assignment of patients to PAs, NPs, or physicians may be random or may depend on scheduling constraints or idiosyncratic interests of the providers involved. In many practices, there will be a mix of substitute and complementary services. Practice patterns may also evolve over time, as individual physicians, PAs, or NPs develop special interests or skills.

Even though the dichotomy of substitute versus complementary services is an oversimplification, at a macro level it will be useful to assess whether, *on average*, addition of PAs or NPs to the national mix of providers has an effect of substituting for or complementing physician services. Information about whether increased resource use can be expected as a consequence of increasing numbers of PAs and NPs, and about the magnitude of any increased resource use, is necessary for the projection of workforce needs.

This project addresses the research question: Is substantive inclusion of PAs in patient care associated with increased numbers of office visits per patient, adjusting for case-mix differences between patients seen by PAs and physicians? If PAs are functioning as substitutes, we would expect no increase in office visit resource use per patient when PAs are included in care. Alternatively, if PAs are providing complementary care, the total number of office visits per patient would be expected to increase when PAs are added to the provider mix. Our study expands upon existing research because it uses a diverse national sample, covers a year of health care experience for each person (rather than a single encounter or episode of care), and employs a validated means of case-mix adjustment. Because the data source does not identify NPs as a distinct category of office visit providers, this study does not include NPs.

METHODS

Study Design

This study uses regression analysis to compare the number of office visits in one year between a group of adults for whom PAs provided care for at least 30 percent of visits and a group who reported care only from physicians.

Data Source

Data are from the Medical Expenditure Panel Survey (MEPS) Household Component office-based visit files from 1996 to 2004 (Agency for Healthcare Research and Quality 2006). MEPS is administered by the Agency for Healthcare Research and Quality to a national probability sample of the noninstitutionalized civilian population. The complex sampling design employs stratification, clustering, multiple stages of selection, and overrepresentation of select subpopulations. Sampling weights that account for this complex design, as well as for nonresponse, are provided for public use by MEPS administrators.

The MEPS samples households and collects information from a single household respondent regarding each household member. Each household remains in the study for 2 years, with data collected from the key respondent in each of five rounds over the 2 years. MEPS uses an overlapping panel design, so that half of each year's participants are in the first year of study participation while the other half are in their second year. The sample for each year is designed to be nationally representative for purposes of calculating national estimates at the family and personal levels.

Outcomes

The primary outcome is the number of office-based visits reported for a person in 1 year. Although MEPS also collects data from events occurring in inpatient, emergency, and hospital outpatient departments, the primary analysis was limited to office-based encounters because PA data are not included in some of the other settings.

In order to assess whether PA care in office-based settings was associated with increased office visit resource use in other settings or with poor outcomes requiring emergent medical attention or admission to a hospital, our secondary analysis compared total yearly hospital outpatient clinic visits, emergency department visits, and hospital discharges between the two comparison groups.

Comparison Groups

A group of patients who reported that a substantive portion of their office-based visits were attended solely by PAs is compared with a group who reported only physician care. Our primary definition of a substantive portion of care is when 30 percent or more of visits in 1 year were reported as provided by a PA. The cutoff point of at least 30 percent of visits is intended to ensure that patients who are studied regarding the impact of PA care have had at least a minimum exposure to PA care. Because 30 percent is the minimum percentage of visits provided by a PA that defines this category, many of the adults in this category received more than 30 percent of their care from PAs. We also evaluate a spectrum of cut-points in order to test the sensitivity of our results to this definition.

The group of 1,762 adults who indicated that PAs were the provider for at least 30 percent of their visits during the study year (the exposed group) is compared with 111,184 control persons who reported that a physician attended all their visits. For convenience, the exposed group will be referred to as the "PA+" group and the control group will be referred to as the "physician-only" group. Persons who reported that providers other than PAs or physicians attended their office visits were excluded. Persons who reported between 0 and 29 percent of office-based care from PAs were also excluded, in order to draw a greater distinction between the two groups. Since the number of annual visits per person is bimodal by age, with children and older patients having the most visits, averages taken from this bimodal distribution could produce misleading results. Because of this, persons <21 years of age were excluded.

For the group with PA+ care, frequency of observations is concentrated in fractions possible for those with few visits. For example, persons with one visit in the year can only have 0 or 100 percent of visits provided by a PA, those with two visits in the year could have 0, 50, or 100 percent, etc. See Supplementary Appendix S1 for additional graphic description of the comparison groups. Because the multimodal distribution of these proportions makes this variable unsuitable for parametric analysis of the continuous variable, we use the dichotomous independent variable described above.

Risk Adjustment

Case-mix adjustment was used to balance the comparison groups on factors that could affect the study outcome. We adjusted for variables in each of the three categories that Anderson proposed to explain health resource use:

predisposing (age, gender, race, and rural versus urban status), enabling (health insurance and socioeconomic status as indicated by the percent of federal poverty level), and need (self-rated health status and medical conditions) factors (Andersen 1995).

Medical conditions for each subject were obtained from the MEPS medical condition files, which aggregate medical conditions that respondents report as the cause of any medical encounters in any setting (including hospitals and emergency departments) during the study period. Conditions for which patients did not seek care will not be included. MEPS professional coders assign ICD-9 codes to verbal descriptions of conditions reported by household respondents as reasons for medical encounters in any setting during the study.

The Ambulatory Diagnostic Groups (ADG) from the Johns Hopkins Adjusted Clinical Group® (ACG) System are a risk adjustment tool for predicting cost and use of health services (Weiner et al. 1992). The ACG system is a case-mix methodology designed for use with ambulatory and inpatient administrative claims data. The ADG clusters are the building blocks of the ACG system and are used to assign each *ICD-9-CM* diagnosis into one of 34 unique diagnostic morbidity clusters based on a variety of factors, including clinical similarity, likelihood of persistence or recurrence, and expected need for continued treatment. Because MEPS reports three-digit ICD-9 codes, we used the modification of the ACG system that is compatible with the three-digit codes.

Statistical Methods

Characteristics of persons in the comparison groups are initially evaluated for group differences using Student's *t*-test for differences in means for continuous variables and χ^2-analysis for categorical variables. To assess the number of office visits and hospital outpatient visits, a negative binomial model with a log-link function was used (Byers et al. 2003). Use of the negative binomial distribution relaxes the strict mean–variance relationship of the Poisson distribution, allowing the variance to exceed the mean. Coefficient estimates from the negative binomial regression can be easily transformed to give the incidence rate ratio. This yields a result that can be interpreted as the percentage increase (or decrease) in total number of visits over the 1-year period for the exposed (PA+) group compared with the control (physician-only) group.

Comparison of total emergency department visits and hospital discharges between the two groups was performed by using the zero-inflated Poisson model (ZIP) (Lambert 1992; Greene 1994). When modeling health care resource use variables that contain a significant portion of zeros, ZIP has the advantage (relative to the traditional two-part model) (Duan et al. 1983) that it takes into account the two processes that generate the zero outcomes: (1) individuals may never use the health service; (2) individuals have the potential to use the service, yet did not use any during the recall period of the study. Because emergency department visits and hospitalizations are more rare compared with outpatient visits, accounting for zero-probability of service use is very important. The ZIP models also produce incidence rate ratios, with interpretation analogous to our other analyses.

All analyses were adjusted for the complex sample design and for nonresponse using MEPS weight, strata, and cluster variables. These variables are designed to produce national estimates representative of the U.S. noninstitutionalized civilian population. All p-values are two-sided.

RESULTS

Table 1 compares the PA+ and physician-only groups regarding the variables used for risk adjustment. Persons in the PA+ group were younger and more likely to be female, white, rural, of higher socioeconomic status, privately insured, and with better self-rated health. These group differences are consistent with other research comparing patients seen by PAs with those seen by physicians (Hooker and McCaig 2001; Morgan 2007) and underscore the need for risk adjustment when comparing use and outcomes between these provider types.

For the ADGs, the PA+ and physician-only groups differed by >4 percent ($p<.05$) for several important categories. The PA+ group is more like to see persons with "Time limited-minor-primary infections" (48 percent of persons in the PA+ group versus 37 percent of persons in the physician-only care group), "Likely to recur-discrete-primary infections" (27 percent for PA+ and 17 percent for physician-only), "Time limited-minor" (25 percent for PA+ and 19 percent for physician-only), and "Allergy" (18 percent for PA+ and 14 percent for physician-only) problems. The physician-only care group was more likely to see persons in the "Chronic medical: stable" (40 percent PA+, 44 percent physician-only) and "Chronic medical: unstable" (15 percent PA+, 20 percent physician-only) groups. These differences are generally

Table 1: Characteristics of PA+ and Physician-Only Groups

	PA+ Care	Physician-Only Care	p-Value*
Age (mean, years)	44.98	50.13	<.0001
Gender			<.0001
Female (%)	65.88	58.34	
Male (%)	34.12	41.66	
Race			<.0001
White (%)	88.33	77.19	
Black (%)	4.47	10.04	
Hispanic (%)	3.98	8.58	
Other (%)	3.21	4.19	
Metropolitan statistical area†			<.0001
Rural (%)	32.62	19.07	
Urban (%)	67.38	80.93	
Poverty category‡			<.0001
Poor (%)	6.68	9.55	
Near poor (%)	3.08	3.84	
Low income (%)	10.61	12.59	
Mid income (%)	34.71	31.01	
High income (%)	44.93	43.00	
Insurance			<.0001
Private insurance (%)	83.81	77.48	
Public insurance (%)	9.46	15.66	
Uninsured (%)	6.73	6.86	
Self-rated physical health			<.0001
Excellent (%)	24.82	21.58	
Very good (%)	40.94	33.07	
Good (%)	25.00	28.68	
Poor (%)	6.71	12.10	
Very poor (%)	2.53	4.57	
No. of visits per year (mean)	4.14	5.55	<.0001
Ambulatory Diagnostic Group (ADG) categories§			
1. Time limited-minor (%)	24.70	18.79	<.0001
2. Time limited-minor-primary infections (%)	48.25	36.87	<.0001
3. Time limited-major (%)	1.64	2.65	.0121
4. Time limited-major-primary infections (%)	1.92	2.18	.5178
5. Allergies (%)	17.78	13.57	<.0001
6. Asthma (%)	5.36	4.61	.1639
7. Likely to recur-discrete (%)	17.70	18.90	.323
8. Likely to recur-discrete-primary infections (%)	26.73	17.18	<.0001
9. Likely to recur-progressive (%)	1.11	2.90	<.0001
10. Chronic medical: stable (%)	39.66	44.27	.0022
11. Chronic medical: unstable (%)	15.01	19.73	<.0001
12. Chronic specialty: stable-orthopedic (%)	1.86	1.19	.057
13. Chronic specialty: stable-ear, nose, and throat (%)	0.70	1.20	.099
14. Chronic specialty: stable-ophthalmology (%)	4.69	6.45	.0163

continued

Table 1. *Continued*

	PA+ Care	*Physician-Only Care*	*p-Value**
15. Chronic specialty: unstable-orthopedics (%)	2.25	2.70	.2763
17. Chronic specialty: unstable-ear, nose, and throat (%)	0.91	0.51	.0321
18. Chronic specialty: unstable-ophthalmology (%)	2.01	3.60	.0014
20. Dermatologic (%)	10.62	8.33	.0078
21. Injuries/adverse events: minor (%)	16.10	13.75	.0137
22. Injuries/adverse events: major (%)	12.48	11.89	.4604
23. Psychosocial, time-limited: minor (%)	4.72	4.18	.3622
24. Psychosocial, recurrent or chronic, stable (%)	15.94	14.52	.1981
25. Psychosocial, recurrent or persistent (%)	0.67	1.63	.0012
26. Signs/symptoms: minor (%)	21.95	22.92	.4627
27. Signs/symptoms: uncertain (%)	17.50	20.71	.0058
28. Signs/symptoms: major (%)	20.73	22.62	.1168
29. Discretionary (%)	8.64	8.76	.8951
30. See and reassure (%)	0.03	0.17	.0229
31. Prevention/administrative (%)	21.51	22.27	.5253
32. Malignancy (%)	2.40	5.15	$<.0001$
33. Pregnancy (%)	2.11	4.21	$<.0001$
34. Dental (%)	4.54	4.04	.3782

*The *p*-values refer to *t*-value for test for difference in means for continuous variables and to χ^2 for difference in proportions for categorical values.

†Metropolitan statistical area using US Census definition.

‡Poverty categories are based on Current Population Survey poverty line. Poor denotes below poverty line, near-poor denotes 100–125 percent of poverty level, low income denotes 125–199 percent poverty level, middle income denotes 200–399 percent of poverty level, and high income denotes over 400 percent of poverty level.

§Ambulatory diagnostic groups are obtained from the Johns Hopkins Adjusted Clinical Group® System. ADG groups 16 and 19 have been discontinued.

For the PA+ group, $N = 1{,}762$. For physician-only group, $N = 11{,}184$.

in the direction of physician-only care predominating among persons with more complex problems, and again demonstrate the necessity of risk adjustment.

Table 2 shows the incidence rate ratios indicating the proportionate contrast in expected number of office visits over the 1-year period for the exposed (PA+) group compared with the control (physician-only) group. For our primary definition of substantive PA care (with a 30 percent cut-point), the risk ratio of .84 indicates that the number of visits per year is reduced by about 16 percent for persons in the PA+ group compared with persons in the physician-only group, adjusted for demographic, geographic, socioeconomic, insurance status, and health factors. When the cut-point was lowered to 10

Table 2: Incidence Rate Ratios for Yearly Office-Based Visit Resource Use Comparing the PA+ Group and the Physician Group at Different Cut-Points for Percentage of Visits to PAs*

Percentage of Visits to PAs only	*N (PA+ Group)*	*N (Physician-Only Group)*	*Incidence Rate Ratio*†	*p-Value*
100	561	111,184	0.45	<.001
≥ 75	649	111,184	0.66	<.001
≥ 50	1,274	111,184	0.74	<.001
≥ 30	1,762	111,184	0.84	<.001
≥ 25	2,048	111,184	0.87	<.001
≥ 10	2,891	111,184	1.02	.196

*Negative binomial model adjusted for age, gender, race, rural–urban status, insurance status, poverty category, self-rated physical health, and 34 ambulatory diagnostic group indicator variables.

†Population-adjusted incidence risk ratio showing proportionate contrast in expected number of office visits over the 1-year period for the exposed (PA+) group compared with the control (physician) group.

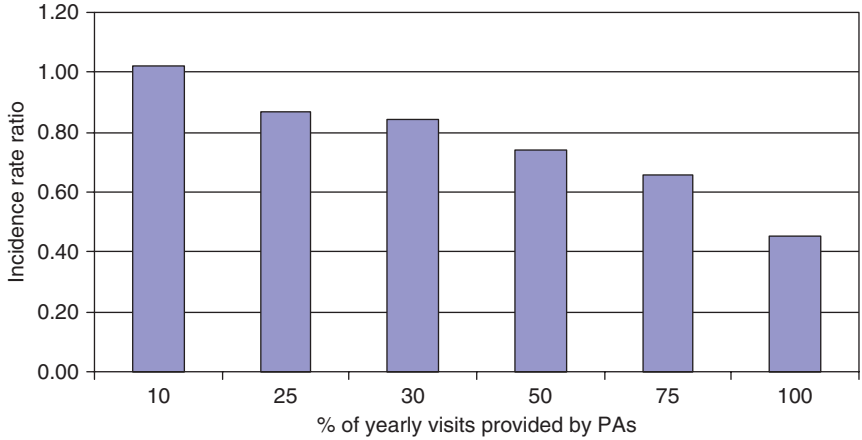
percent, there was no difference seen between the comparison groups. Above the level of at least 25 percent of visits provided by a PA, substantive PA participation in care is associated with fewer office-based visits per year. As the proportion of PA visits used to define the PA+ group increases, the number of office visits per year consistently decreases in a dose–response pattern (Figure 1).

Table 3 shows the results of the secondary analysis examining whether reduced office visit use in the PA+ group was offset by increased number of visits in other settings. Persons in the PA+ group had about 25 percent fewer emergency department visits ($p<.05$). The results for hospital outpatient and inpatient settings were not statistically significant.

DISCUSSION

In this national sample from the United States, adults who reported receiving substantive care from PAs (30 percent or more of yearly office-based visits) were younger, healthier, and less medically complex than those who reported seeing physicians only. After controlling for demographics, socioeconomic status, insurance status, health status, and medical conditions, these persons had about 16 percent fewer office-based visits per year than those who reported receiving only physician care.

Figure 1: Incidence Rate Ratios for the PA+ group Compared with the Physician-Only Group at Different Cut-Points for Percent of Visits to PAs*



*Population-adjusted incidence risk ratio showing proportionate contrast in expected number of office visits over the 1-year period for the exposed (PA+) group compared with the control (physician-only) group. Incidence risk ratio was not statistically significant at the 10 percent cut-point.

The decreased number of office visits that we found with substantive PA care may be due to differences between the comparison groups that were not balanced by our risk adjustment procedures. For example, it may be that, within

Table 3: Incidence Rate Ratios for the PA+ Group Compared with the Physician Group for Other Health Care Settings*

Clinical Setting	*Incidence Rate Ratio*‡	*p-Value*
Hospital-based outpatient clinics*	0.86	>.1
Emergency department†	0.76	<.05
Inpatient discharges†	0.84	>.1

*Negative binomial model adjusted for age, gender, race, rural–urban status, insurance status, poverty category, self-rated physical health, and 34 ambulatory diagnostic group indicator variables.

†Zero-inflated Poisson model adjusted for age, gender, race, rural–urban status, insurance status, poverty category, self-rated physical health, and 34 ambulatory diagnostic group indicator variables.

‡Population-adjusted incidence risk ratio showing proportionate contrast in the expected number of episodes of care over the 1-year period for the exposed (PA+) group compared with the control (physician) group. Cut-off for the definition of PA+ group is at least 30 percent of office-based visits provided by a PA.

practices or health systems, PAs are assigned patients who are expected to require fewer visits than those assigned to physicians, and that the characteristics behind these decisions are relatively intangible and not reflected by our control variables. Although the Adjusted Clinical Group® System that we used for risk adjustment has been validated to predict health resource use (Weiner et al. 1992), risk adjustment can never completely eliminate selection bias. Our results indicating that the group with substantive PA care also had fewer emergency department visits suggest that this group may have been more healthy than the physician-only group. Thus, residual selection bias may explain our finding of fewer office visits per year among the group with substantive PA care.

Another potential explanation for our finding is that, as persons have more health care visits, they are more and more likely, by chance, to encounter a PA, but less likely to stay above the threshold cut-points (10, 25, 30 percent, etc.) used in our analysis. If this is true, our primary independent variable (substantive PA care) could be endogenous with our outcome variable (number of visits per year). For a discussion of this problem, and of our efforts to address it, see Supplementary Appendix B.

When interpreting these findings, it is important to account for the strengths and limitations of MEPS data for research on PAs. Because household respondents may not accurately report the type of provider who saw a patient, the "physician-only" group likely contains some persons who were seen by a PA or another provider type that was incorrectly identified as a physician on the MEPS survey. Also, because MEPS only represents visits to a PA when a physician was not also seen, some persons in the control group were likely exposed to PAs on visits when they also saw the physician. The magnitude of this contamination is difficult to quantify. Although MEPS likely underrepresents the extent of PA participation in care (Morgan et al. 2007), MEPS still provides a relatively large national sample that is diverse with regard to patient demographics, geography, socioeconomic status, type of health plan, and health status. MEPS data provide one of the few national representative longitudinal sources of information about national patterns of health care use. The longitudinal design is well-suited to our research question because it supports the analysis of a person's care over time, rather than only at an individual health care encounter. In addition, the MEPS pattern of surveying respondents every 4–5 months minimizes recall bias more than surveys that query respondents about events over a full year. In sum, while MEPS has weaknesses for this research, it likely provides one of the best data sources available to investigate the effect of PAs on resource use.

Overall, these results indicate that under the practice conditions and relative prevalence of PAs and physicians in the health workforce between 1996 and 2004, PAs tended to serve as substitutes, rather than complements, for physician services. This suggests that an increase in the number of PAs in the provider mix should not be expected to increase per person office visit resource use. It is not possible to predict whether there is some point at which the impact of adding PAs to the workforce might change. It is possible that, when the ratio of PAs to physicians reaches a certain point, addition of more PAs could begin to change the type and amount of services provided.

CONCLUSIONS

Our results indicate that, after adjustment for a variety of indicators of patient complexity, use of PAs as the sole provider for a substantive portion of office-based visits was not associated with increased per person office visit resource use. Our study found that a group of adults with 30 percent or more of yearly visits attended by PAs alone had, on average, about 16 percent fewer visits per year. This difference could be from residual selection bias due to factors not accounted for in MEPS. Still, this study suggests that the addition of PAs to the provider mix will not increase per person office visit resource use. In this respect, our findings indicate that PAs serve more to extend physician services to patients than to play a complementary role that leads to increased health care resource use.

If predicted physician shortages (Association of American Medical Colleges 2006) materialize, and if the rapid growth of the PA profession continues (Hooker 2002), PAs will provide a larger share of patient care in the United States in the future. Because labor costs for PAs are lower than those of physicians, results of this study suggest that the use of PAs may increase efficiency in health care delivery.

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SUPPLEMENTARY MATERIAL

The following supplementary material for this article is available online:

Appendix SA1: Author Matrix.

Appendix A: Additional Graphic Description of Data.

Figure A1: Frequency Distribution of Number of Visits per Year to PAs.

Figure A2: Frequency Distribution of Number of Visits per Year to Physician-Only Group and to PA+ Group.

Figure A3: Distribution of Portion of Visits Provided by PAs Among Persons Who Saw PAs.

Table A1: Distribution of Number of Visits per Year, Total Sample.

Appendix B: Endogeneity Bias and Alternative Analyses.

Table B1: Quantile Regression Analysis Results.

Table B2: Propensity Score Analysis with Stratified Matching.

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