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A Comparison of Resource Utilization in Nurse Practitioners and Physicians

CONTEXT. Nurse practitioners increasingly provide primary care in a variety of settings. Little is known about how resource utilization for patients assigned to nurse practitioners compares with that for patients assigned to physicians.

OBJECTIVE. To compare health care resource utilization for adult patients assigned to a nurse practitioner with that for patients assigned to a resident or attending physician.

DESIGN. Prospective, quasi-randomized study.

SETTING. Primary care clinic at a Veterans Affairs medical center.

PATIENTS. 450 new primary care patients: 150 were assigned to a nurse practitioner, 150 to a resident physician, and 150 to an attending physician.

OUTCOME MEASURES. We collected data on laboratory and radiologic testing, specialty care, primary care, emergency or walk-in visits, and hospitalizations over a 1-year period. We also collected information on baseline chronic illnesses, blood pressure, and weight.

RESULTS. Resource utilization for patients assigned to a nurse practitioner was higher than that for patients assigned to a resident in 14 of 17 utilization measures (3 were statistically significant) and higher in 10 of 17 measures when compared with patients assigned to an attending physician (3 were statistically significant). None of the utilization measures for patients in the nurse practitioner group was significantly lower than those for either physician group.

CONCLUSIONS. In a primary care setting, nurse practitioners may utilize more health care resources than physicians.

Nurse practitioners have assumed increasing responsibility and independence in a variety of health care settings. As their number grows, so does the controversy over their role in the U.S. health care system.[1] According to a recent count, there are approximately 63,000 actively employed nurse practitioners, and this number is projected to increase to over 100,000 by the year 2005.[2]

The effectiveness of nurse practitioners in providing primary care is the subject of ongoing debate.[3–5] Some assert that when measures of quality and cost are used, the primary care provided by nurse practitioners is equivalent or superior to that provided by physicians.[3] The effectiveness of nurse practitioners when working in collaboration with physicians has been studied in such areas as family practice,[6] prevention and health education,[7, 8] specialty care (e.g., HIV,[9] diabetes,[10] rheumatology,[11] and congestive heart failure[12]), treatment of minor illnesses,[8, 13, 14] and performance of certain procedures (e.g., screening flexible sigmoidoscopy).[15] However, research on the effectiveness of nurse practitioners to date has been limited by methodological shortcomings, including

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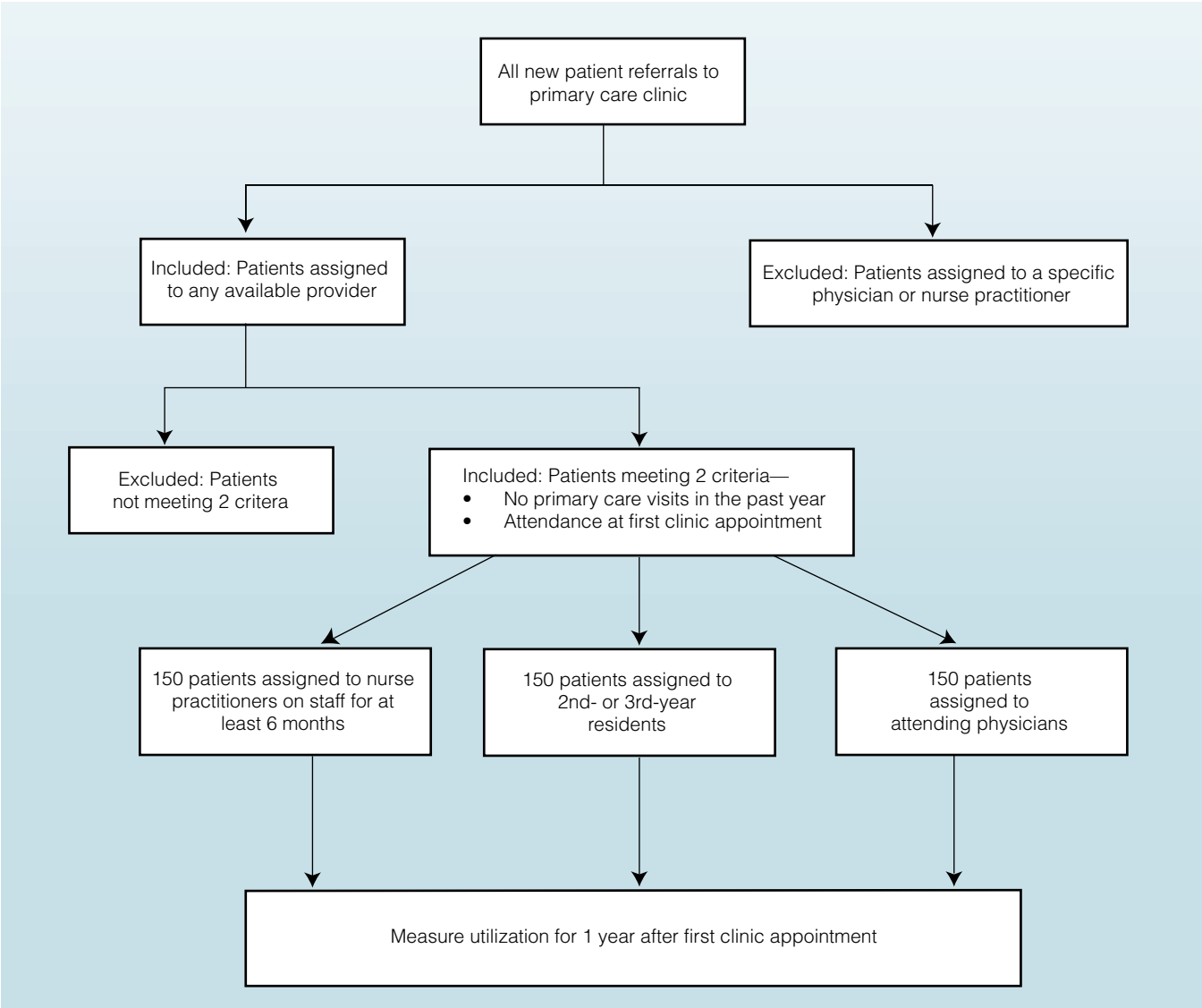

FIGURE 1. Study design.

small sample size, lack of appropriate controls, heterogeneous practice settings, nonrandomized assignment of patients, failure to account for differences in the severity of illnesses, and a focus on short-term outcomes.[4, 16]

Despite the lack of research in this area,[17] nurse practitioner advocates have asserted that these practitioners are more cost-effective than physicians.[3, 18] Such claims are generally based on the lower salary and lower cost of malpractice insurance and education for nurse practitioners compared with physicians.[18–20] However, these savings are at least partially offset by the cost of physician supervision and the higher number of patients and greater complexity of the cases generally seen by physicians.[17, 18, 20] Moreover, the potential savings accrued by using nurse practitioners may be offset by increased utilization of other health services,[5] such as specialty care and diagnostic testing. The differences in training of physicians and nurse practitioners are well-known, but the effect of these differences on use of diagnostic testing and referrals is not. Nurse practitioners may be less comfortable with diagnostic uncertainty and complexity[4] and may rely more on testing and referrals in these situations. On the other hand, physicians may be more technology oriented or more concerned about missing rare conditions and may order more tests during the diagnostic work-up.[21]

These issues are particularly important to the Department of Veterans Affairs, which extensively uses the services of nurse practitioners and plans to expand their number and autonomy in practice.[22] We did a study in the Baltimore Veterans Affairs Medical Center (VAMC) to compare resource utilization patterns for patients assigned to a nurse practitioner with those for patients assigned to a physician.

TABLE 1
Provider Characteristics

DEMOGRAPHIC INFORMATION	NURSE PRACTITIONERS	MEDICAL RESIDENTS	ATTENDING PHYSICIANS
Number	9	35	10
Female	100%	23%	70%
Average years in practice	13.3	<3	7.3
Average number of half-day sessions/wk	5.7	1	2.5

Methods

Study Design

All new primary care referrals were reviewed by a nurse practitioner who assigned them to a physician, nurse practitioner, or any available provider, depending on the severity of the problems listed on the referral. In practice, most patients were assigned to any available provider, and these patients were then scheduled by a clerk on a computerized system for the next available appointment, regardless of the type of provider. As shown in **Figure 1**, our study sample makes use of this quasi-random assignment.

Setting

The study was conducted at the primary care clinic of the Baltimore VAMC, where primary care is provided by 35 residents, 10 attending physicians, and 9 nurse practitioners (**Table 1**). First-year residents and newly graduated nurse practitioners are required to present every patient to the attending physicians during the first 6 months of their appointment, whereas the remainder of the residents and nurse practitioners present cases only when they believe it to be necessary. In general, there is one attending physician for every three to four nurse practitioners or residents. The attending physicians do not see their own patients during their period of supervision and precept during half-day sessions; as a result, nurse practitioners often work with several attending physicians. These physicians are required to review and countersign all nurse practitioner and resident visit charts. However, approval of the attending physician is not required for referrals, tests, or treatment plans.

Study Sample

Patients assigned to "any available provider" who fulfilled the eligibility criteria (new referrals to the primary care clinic after July 1, 1994; no primary care visits in the year preceding the initial visit; assigned to a second- or third-year resident, a nurse practitioner who had been on staff for more than 6 months, or an attending physician; and had a first clinic appointment) were the participants in our study. All patients who qualified for the study were divided into two groups, nurse practitioner or physician. The physician group was further divided into two subgroups, resident and attending physician, to determine whether use of physicians in training would influence the overall results. The first 150 patients who qualified for each group were followed for the duration of the study. Patients were recruited over a 1-year period.

For the purposes of this study, patients remained in the group to which they were initially assigned, even if their type of primary care provider changed after the first visit. The practitioners at the Baltimore VAMC were aware that a study of utilization patterns was being conducted but did not know which patients were included.

Data Collection

Data were extracted from computer records of the VA Maryland Health Care System (Baltimore, Perry Point, Fort Howard, and Cambridge medical centers) for 1 year after the first visit. We obtained the patient's age and sex from this system. We collected the total number of laboratory tests ordered and selected individual tests (urinalysis, cholesterol, complete blood count, creatinine, thyroid function tests, and prostate-specific antigen); each numerical value was counted as a separate test as it appeared on the test order form. We also collected the number of radiologic studies and type of study done during the 1-year period after the initial primary care visit. Data on the number of hospital admissions, primary care visits, emergency department or walk-in visits, and selected visits to specialty clinics were also collected. Specialty clinic visits were divided into the following three categories: medical (all medical subspecialties plus dermatology and neurology), surgical (all surgical specialties and podiatry), and ophthalmology/optometry. Elective, same-day admissions for procedures and minor surgery and testing done during a period of hospitalization were excluded.

The clinic chart from the patients' initial visit was reviewed to collect data on the following chronic conditions noted at this visit: coronary artery disease, congestive heart failure, diabetes mellitus, stroke, chronic obstructive pulmonary disease, peripheral vascular dis-

ease, chronic liver disease, cancer (except nonmelanoma skin cancer), chronic renal insufficiency, hypertension, chronic mental illness, and alcoholism or substance abuse. The patient's weight and blood pressure at the first visit were also recorded.

Statistical Analysis

We used the chi-square test to compare the distribution of categorical variables and the Student *t*-test to compare the means of continuous variables between the nurse practitioner and physician (attending and resident) groups. The Fisher exact test was used to compare the prevalence of infrequent conditions. To measure diverse resource utilization between the nurse practitioner and physician groups, we created relative estimate variables by dividing measures of resource utilization in the nurse practitioner group by the corresponding measure in either physician group. We considered using multiple regression analysis to compare the main utilization variables between the two provider groups while controlling for comorbid conditions recorded from chart review. However, we decided against this because of the quasi-random design of our study and the possible confounding factor of documentation bias (i.e., that differences in comorbid conditions at baseline may have resulted from differences in documentation).

Results

Patient Characteristics

All patients were similar in age, sex, baseline blood pressure, and weight. The rates of overall and individual chronic illnesses were also similar (**Table 2**).

Utilization by Nurse Practitioners Relative to Resident and Attending Physicians

Figure 2 shows the relative utilization rates and 95% confidence intervals for 17 distinct utilization measures. Resource utilization for patients assigned to a nurse practitioner was higher than that for patients assigned to a resident physician in 14 of 17 measures and was higher in 10 of 17 measures when compared with an attending physician. **Table 3** provides the baseline rate for each of 17 measure and for 3 summary measures: total laboratory tests, total radiology tests, and total specialty visits.

Laboratory Testing

No significant difference was found in the total number of laboratory tests performed between the nurse practitioner and physician groups. This was also true for most of the selected individual laboratory tests except for urinalysis and thyroid function tests, which were performed significantly more often in the nurse practition-

TABLE 2
Baseline Characteristics of Study Participants by Type of Provider*

CHARACTERISTIC	NURSE PRACTITIONER (*n* = 150)	RESIDENT (*n* = 150)	ATTENDING PHYSICIAN (*n* = 150)
Mean age, *yr*	62	62	60
Women, *n*	1	6	1
Charts reviewed, *n*	123	120	129
Mean weight, *lb*	185	191	189
Mean systolic blood pressure, *mm Hg*	140	141	136
Mean diastolic blood pressure, *mm Hg*	80	82	79
Hypertension	42%	52%	52%
Diabetes mellitus	20%	22%	19%
Coronary artery disease	18%	22%	19%
Congestive heart failure	5%	10%	7%
Cerebrovascular accident	4%	11%	5%
Chronic obstructive pulmonary disease	5%	11%	9%
Substance abuse	12%	13%	20%
Psychiatric illness	7%	6%	7%
Cancer	9%	7%	5%
Peripheral vascular disease	4%	2%	5%
Chronic renal insufficiency†	0%	5%	2%
Liver disease	2%	0%	1%
Chronic conditions per patient, *n*	1.3	1.6	1.5

**Weight, blood pressure, and data on comorbid conditions were found on 83% of charts reviewed.*
†$P < 0.05$

er group than in the resident group. Of note, the difference in the performance of urinalysis for diabetic patients and cholesterol screening between the three groups was not significant.

Radiologic Studies

The number of radiologic studies ordered by the nurse practitioner group was higher than that of either physician group and was especially higher than that of the attending group. The difference between attending physician and nurse practitioner groups was statistically significant for ultrasonography, computed tomography, and magnetic resonance imaging.

Patient Visits and Hospitalizations

The difference between the number of primary care visits between the nurse practitioners and attending physicians was significantly higher than that in the resident group (3.52 and 4.03 for nurse practitioners and attending physicians, respectively, vs. 2.95 for residents). Emergency department or walk-in visits were similar among the three groups. Patients in the nurse practitioner group had more visits to specialists than did patients in the resident and attending physican groups, but the difference was not significant ($P = 0.12$) except for ophthalmalogy/optometry visits in the nurse practitioner group compared with the attending physi-

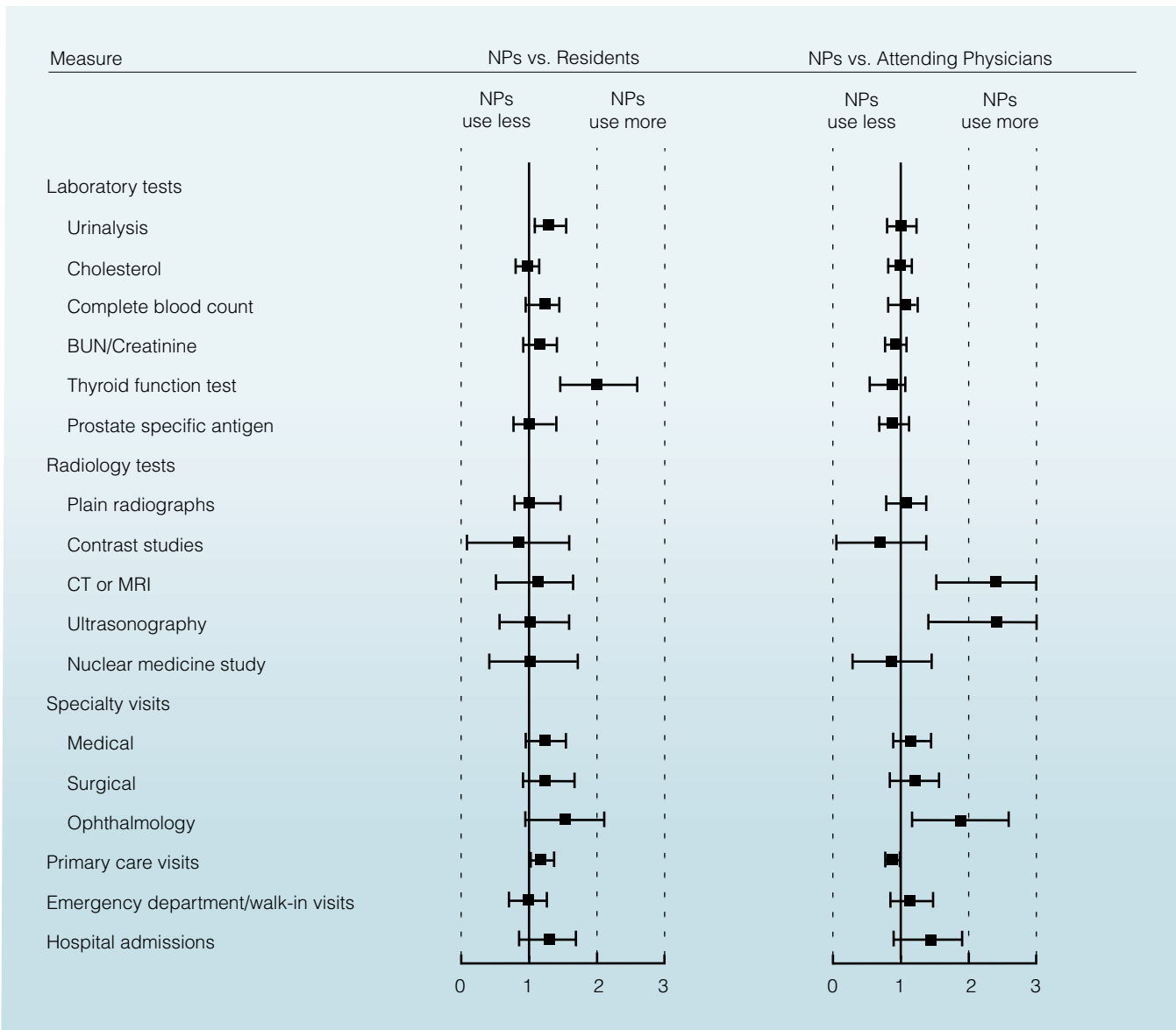

FIGURE 2. Relative utilization for 17 measures of resource use and 95% CIs. BUN = blood urea nitrogen; CT = computed tomography; MRI = magnetic resonance imaging; NPs = nurse practitioners.

TABLE 3

Resource Utilization Rates by Type of Provider*

MEASURE	MEAN UTILIZATION RATE (PER PATIENT PER YEAR)		
	NURSE PRACTITIONER	RESIDENT	ATTENDING PHYSICIAN
Total laboratory tests	29.46	28.26	32.67
Urinalysis	1.31	0.99†	1.25
Cholesterol	1.09	1.1	1.1
Complete blood count	2.11	1.74	2
BUN/Creatinine	2.11	1.81	2.26
Thyroid function	0.37	0.19†	0.46
Prostate-specific antigen	0.51	0.47	0.56
Total radiology tests	1.68	1.48	1.37
Plain radiographs	1.03	0.89	0.95
Contrast studies	0.07	0.08	0.09
CT or MRI	0.32	0.27	0.13‡
Ultrasonography	0.16	0.15	0.07‡
Nuclear medicine studies	0.1	0.09	0.12
Total specialty visits	5.35	4.21	4.26
Medical	2.41	1.97	2.1
Surgical	2.01	1.64	1.67
Ophthalmology	0.93	0.6	0.49‡
Primary care visits	3.52	2.95†	4.03
Emergency department/walk-in visits	1.22	1.23	1.05
Hospital admissions	0.43	0.33	0.31

**BUN = blood urea nitrogen; CT = computed tomography; MRI = magnetic resonance imaging.*
†Nurse practitioners vs. medical residents, $P < 0.05$.
‡Nurse practitioners vs. attending physicians, $P < 0.05$.

cian group. Of note, the rate of ophthalmology visits for diabetic patients in the three groups was not significant. There was a tendency toward increased hospitalization in the nurse practitioner group, but this did not reach statistical significance. Mortality rate was similar among the three groups; there were five deaths over the 1-year period in the nurse practitioner group, six in the resident group, and three in the attending physician group.

Comparison of Resident and Attending Physicians

Although the focus of our study was to compare nurse practitioners with physicians, we also compared utilization measures in the resident and attending physician groups. Utilization of most tests and specialty and acute care services was similar for both groups. The only significant differences were that patients in the attending physician group had more thyroid function tests (0.46 vs. 0.19 per patient, $P < 0.02$) and primary care visits (4.03 vs. 2.95 per patient, $P \leq 0.01$) than the patients assigned to a resident.

Discussion

Nurse practitioners are increasingly assuming the role of primary care provider in a variety of settings. Our study was designed to determine whether assignment to different types of primary care practitioners would influence resource utilization. Overall, we found a trend toward increased utilization for patients assigned to a nurse practitioner in several measures, but for most of these our study lacked sufficient power to show statistical significance. This was because of the wide variation in utilization rates for individual patients.

The results of our study show little difference in the utilization rates of laboratory tests between patients assigned to nurse practitioners and those assigned to physicians. Previous research has indicated that most laboratory

tests are ordered for the purpose of screening or monitoring,[23] and nurse practitioners and physicians probably follow similar protocols or guidelines in this regard, particularly when they practice in the same setting.

Despite similar numbers of relatively low-cost blood and routine radiologic testing in the three groups, patients assigned to nurse practitioners had more of the expensive ultrasonography, computed tomography, and magnetic resonance imaging studies than did patients assigned to attending physicians. This casts doubt on the argument that nurse practitioners are less technology-oriented than physicians and are therefore less likely to order expensive tests.[3] There are several possible explanations for this difference. Nurse practitioners may have encountered more uncertainty in their practice and ordered more of these tests in search of a diagnosis. Another possible explanation is that attending physicians were uncomfortable with the uncertainty inherent in joint management of patients with nurse practitioners and recommended such tests as a result. A third explanation would be that the increased use of these tests resulted from an increased number of visits to specialists (i.e., the tests were ordered by specialists and not the primary care provider). Regardless of the reason, increased use of nurse practitioners as primary care providers may lead to increased ordering of expensive diagnostic tests.

The rates of primary care and emergency department or walk-in visits were also similar for patients assigned to nurse practitioners and physicians (except for the lower rate of primary care visits in the resident group). However, there were more specialty visits and hospital admissions for patients assigned to a nurse practitioner, especially when compared with the attending physician group. The higher number of inpatient and specialty care resources utilized by patients assigned to a nurse practitioner suggests that they may indeed have more difficulty with managing patients on their own (even with physician supervision) and may rely more on other services than physicians practicing in the same setting. The 41% increased hospitalization rate in the nurse practitioner group translates into 13 more hospital admissions per 100 patients per year, and the 25% increase in specialty visits translates into 108 more visits per 100 patients per year. These differences may offset or negate any cost savings achieved by hiring nurse practitioners in place of physicians. It is possible, on the other hand, that the increased utilization rates seen in patients in the nurse practitioner group were due to an unmeasured difference in comorbid conditions or severity of illness that was not captured through our chart review. However, this review suggested that, if anything, there was a tendency toward higher rates of chronic illness for patients in the physician groups.

Unfortunately, little research in the past has compared the utilization patterns of nurse practitioners with physicians in primary care.[17] The closest study that we could find compared physicians, physician assistants, and nurse practitioners in Air Force primary care clinics.[24] Overall, this study found similar rates of test ordering (per visit) among the three groups; however, the cases were not comparable and physicians cared for the "more difficult patients" (this was not further defined). For evaluation of test ordering for particular disorders, this study found that nurse practitioners were three times more likely than physicians to order radiographs for "backache" (27.6/100 visits vs. 8.6/100 visits). This finding seems to be consistent with our results and suggests that nurse practitioners may use more of other resources than physicians when addressing similar problems.

The strength of our study is that it is the first to compare nurse practitioners and physicians in primary care practice by prospectively following patients with similar demographic information and baseline chronic illnesses, achieved by using a method similar to random allocation without interfering with existing practice. Another strength was that the nurse practitioners followed in this study were experienced (average, 13 years in practice). The nurse practitioners also were the exclusive primary care provider for the patients assigned to them—they did not share panels of patients with physicians, making the model of care at our institution closer to independent practice than many other settings in which nurse practitioners and physicians share panels.

However, our study is limited by several factors. First, in contrast to some managed care systems, tests and referrals at the Baltimore VAMC can be ordered by any practitioner, not just the primary care provider, and we did not have the capability to accurately identify the provider who ordered each test. This tends to dilute potential differences in the practices of the three types of primary care providers because they rely on the same pool of specialty services. Second, we looked at the practice of relatively few providers; therefore, the results could be influenced by variations in the practice of individual providers within each group.

We think it is important to emphasize that our study evaluated the practices of nurse practitioners who were supervised full-time by dedicated attending physicians; although the nurse practitioners were not required to get approval for testing or referrals, the presence of these physicians probably influenced their prac-

tice and brought it closer to physician norms. If indeed this was the case, then the differences that did exist may be magnified in an independent nurse practitioner practice or settings in which nurse practitioners collaborate with physicians who are busy seeing their own patients.

In conclusion, our study suggests that the use of nurse practitioners in certain primary care settings may increase the utilization of health services, particularly specialty and inpatient care. More research needs to be done to determine whether this is indeed the case and, if so, how these differences may affect the quality of care and overall costs as nurse practitioners increasingly take the place of physicians in providing primary care.

Take-Home Points

- **Although nurse practitioners are assuming more extensive clinical roles in primary care settings, resource utilization by these providers has been largely unexplored.**
- **To compare the practices of nurse practitioners, residents, and attending physicians, we performed a prospective study of resource utilization in 450 patients enrolled in a primary care clinic at a Veterans Affairs medical center.**
- **Compared with residents, nurse practitioners had higher utilization rates for 14 of the 17 measures assessed in this study.**
- **Compared with attending physicians, nurse practitioners had higher utilization rates for 10 of the 17 measures assessed in this study; the largest differences were found in the use of advanced imaging tests (ultrasonography, computed tomography, and magnetic resonance imaging).**
- **The findings of our study should be considered preliminary and warrant investigation in other settings.**

References

1. Warshaw R. Too much independence for NPs? ACP Observer. 1998;18:1, 12-3.
2. Cooper RA, Laud P, Dietrich CL. Current and projected workforce of nonphysician clinicians. JAMA. 1998;280:788-94.
3. Mundinger MO. Advanced-practice nursing—good medicine for physicians? N Engl J Med. 1994;330:211-4.
4. Kassirer JP. What role for nurse practitioners in primary care? N Engl J Med. 1994;330:204-5.
5. Rudy DR. Advance practice nurses. Should they be independent? Arch Fam Med. 1995;4:14-6.
6. Spitzer WO, Sackett D, Sibley JC, et al. The Burlington randomized trial of the nurse practitioner. N Engl J Med. 1974;290:251-6.
7. Brown SA, Grimes DE. A meta-analysis of nurse practitioners and nurse midwives in primary care. Nurs Res. 1995;44:332-9.
8. Zentner J, Dellinger C, Adkins WE, Greene J. Nurse practitioner provided primary care: managing health care costs in the workplace. AAOHN J. 1995;43:52-3.
9. Aiken LH, Lake ET, Semaan S, et al. Nurse practitioner managed care for persons with HIV infections. Image J Nurse Sch. 1993;25:172-7.
10. Stein GH. The use of a nurse practitioner in the management of patients with diabetes mellitus. Medical Care. 1974;12:885-90.
11. Hill J, Bird HA, Harmer R, Wright V, Lawton C. An evaluation of the effectiveness, safety and acceptability of a nurse practitioner in a rheumatology outpatient clinic. Br J Rheumatol. 1994;33:283-8.
12. Cintron G, Bigas C, Linares E, Aranda JM, Hernandez E. Nurse practitioner roles in a chronic congestive heart failure clinic: in-hospital time, costs, and patient satisfaction. Heart Lung. 1983;12:237-40.
13. Komaroff AL, Sawayer K, Flatley M, Browne C. Nurse practitioner management of common respiratory and genitourinary infections, using protocols. Nurs Res. 1976;25:84-9.
14. Marsh GN, Dawes ML. Establishing a minor illness nurse in a busy general practice. BMJ. 1995;310:778-80.
15. Maule WF. Screening for colorectal cancer by nurse endoscopists. N Engl J Med. 1994;330:183-7.
16. American College of Physicians. Physician assistants and nurse practitioners. Ann Intern Med. 1994;121:714-6.
17. DeAngelis CD. Nurse practitioner redux. JAMA. 1994;271:868-71.
18. McGrath S. The cost-effectiveness of nurse practitioners. Nurs Pract. 1990;15:40-2.
19. Jaycox A. The OTA report: a policy analysis. Nurs Outlook. 1987;35:262-7.
20. Nichols LM. Estimating costs of underusing advance practice nurses. Nurs Econ. 1992;10:345-5, 348-51.
21. Fagin C. Can APNs be independent gatekeepers? Yes. Hospital & Health Networks. June 5, 1993;8.
22. Kizer KW. Under secretary for health's information letter: utilization of nurse practitioners and clinical nurse specialists. July 7, 1997. Unpublished data.
23. Wertman BG, Sostrin SV, Pavlova Z, Lundberg GD. Why do physicians order laboratory tests? A study of laboratory test request and user patterns. JAMA. 1980;243:2080-2.
24. Goldberg GA, Jolly DM, Hosek S, Chu DS. Physician's extenders' performance in Air Force clinics. Med Care. 1981;19:951-65.

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