PHYSICIAN ASSISTANT

The Economic Basis of Physician Assistant Practice

Roderick S. Hooker, PhD, PA

ABSTRACT

The performance of physician assistants (PAs) has been of interest to the health workforce and policy analysts since the introduction of the PA profession in the mid-1960s. Most of the economic research has focused on cost-effectiveness, using physicians or nurse practitioners for comparison. A review of the literature finds that a PA can safely assume at least 83% of all primary care visits without direct physician supervision. Using the substitution ratio, a PA can perform at least 75% of a physician's tasks at a cost of 44% of the physician's salary, based on 1999 average primary care salaries for physicians and PAs. Cost-benefit analyses of PA-delivered primary care suggest the use of resources is less than physicians under comparable circumstances. The cost of training a PA is approximately one fifth that of an allopathic physician. Because of the difference in length of education between PAs and physicians, the PA provides 5 years of patient care valued at $380,000 (1999 dollars) before the physician completes a primary care residency and enters health care practice. These factors, plus the compensation-to-production ratio, establish the PA as one of the most cost-effective health care clinicians to employ.

Are physician assistants (PAs) cost-effective practitioners? Are they productive enough to be considered replacements for physicians? If they are cost-effective, do the benefits of PA services accrue to the employer, the patient, or to society as a whole?

A central issue in today's health care marketplace is the cost-effectiveness of PAs and their financial impact in clinical practice. A number of PA performance characteristics have been described in research. For example, 10 studies have shown that PAs provide lower cost health care, within their spheres of practice competency, that is comparable, and in some instances superior, to that provided by physicians.[1] Many of these studies, although performed years ago, still appear to be valid.[2,3]

Roderick Hooker is an associate professor and Chief of the Division of Health Sciences Research at the University of Texas Southwestern Medical Center, Department of Physician Assistant Studies, Dallas, Tex.

Although PA cost-effectiveness has not been conclusively demonstrated in all practice settings,[4] substantial research evidence confirms that PAs are cost-effective in most settings.[5-7] This study is a systematic review of the literature on PA labor economics.

BACKGROUND

Since the early 1970s, the performance of PAs in the delivery of medical care services has been extensively studied. Motivations for this research were mixed—some researchers wanted to document the PAs' effectiveness while others thought the stories of PA utilization were inflated. Few fledgling professions have undergone such scrutiny. Spitzer notes that "the introduction of physician assistants has been a responsible policy and many other innovations mediated by medical practitioners have gained widespread acceptance with much less rigorous

prior evaluation than was given to physician assistants."[8]

In the first summary of PA studies in 1975, the US General Accounting Office reported no difference in the fees charged by physicians and PAs.[9] However, PAs' precise degree of productivity and cost-effectiveness remained difficult to determine because the vast majority of PA productivity studies have viewed the PA as a physician substitute rather than as a member of an interdisciplinary health care team.[10]

Almost all the economic research on PAs has examined cost-effectiveness of PA employment. Cost-effectiveness analysis is an economic technique designed to compare the positive and negative consequences of a specific resource allocation. Basically, it seeks to measure the comparable benefit of a particular investment versus the cost. The application of a cost-effectiveness analysis to the delivery of medical care services and, more specifically, to the provider of such services is a complex endeavor. It is difficult to accurately measure the content of a medical encounter, given variations in such factors as severity of illness, types of treatment, patient preferences, and use of diagnostic tests. Add the types of provider delivering similar services and their different styles of task delegation to these factors differences, and the complexity and potential expense of research about cost-effectiveness becomes clearer.

SUBSTITUTES OR COMPLEMENTS

Many studies examining the PA role have tried to answer whether PAs substitute for (replace) or complement (enhance) physicians. In medical care, it is not always easy to know when an input is a complement or a substitute based solely on the task performed. If the PA works for the physician and the physician determines the performance or directs the task, then the PA is a complement and will increase the physician's productivity. If, on the other hand, the PA performs the same task and is operating relatively independently of the physician, then the PA is a substitute for the physician in providing that service.

The essential element in determining whether an input is complementary or a substitute is who controls the use of that input.[11] Substitutability, as the term is used here, implies that quality of care is not threatened. In examining the literature on this question, Sox concluded that a PA should be able to "provide the average office patient with primary care that compares very favorably with care given by the physician."[12]

A REVIEW OF THE LITERATURE

The substitutability of PAs for physicians depends on the volume of services delegated and the degree to which the productivity of the PAs and physicians performing these services is the same. Delegation and productivity numbers can be combined to produce a physician–PA substitution ratio. If the physician's services are delegated to a PA and the PA's productivity is one half that of the physician, one PA can substitute for half of a physician and the substitution ratio will be .50 physician/1 PA, or .50.

The majority of studies evaluating PA performance have found that PAs can provide 60% to 100% of the services performed by primary care physicians (PCPs) without consultation (substitution).[6,13-19] The most rigorous of these older studies showed that the substitution ratio using a traditional primary care office setting is at least .83; that is, it takes one PA to substitute for eight tenths of a physician.[6]

If we accept that PAs are at least three quarters as productive as physicians, are capable of managing at least 83% of all primary care encounters, and that the mean PA salary is one half of a primary care physician, we can begin to appreciate the complexity of cost-effectiveness analysis. This evaluation becomes more complicated because of the multiple terms economists use to describe the health workforce: practice arrangements, delegation, supervision, consultation, and cost-effectiveness.

PRACTICE ARRANGEMENTS

A practice arrangement is the composition of the health care setting. It can be a group or individual practice, a hospital outpatient clinic, a managed care organization, or any number of administrative arrangements for medical care provision. Because the ini-

Table 1
THE DELEGATION OF OFFICE VISITS TO PAS: A SUMMARY OF THE LITERATURE

Reference	Study Period	Setting	Patients	Triage Method	Delegation Level
Record[4]	1971–73	HMO	200,000 health plan enrollees	Receptionist	79%
Record[6]	1972	HMO	200,000 health plan enrollees	Receptionist	83%
Pondy[59]	1972	HMO, Group, solo (2), institution	Unknown	Not described	81% HMO 36% Group 39% Solo 24% Solo
Milestones[60]	1971–74	Solo	27,000 rural Appalachia	N/A	33%
Henry[61]	1971–72	Satellite/Independent	3500 rural Florida	All patients seen by PA	80%
Riess[62]	1974	Satellite/Independent	5300 rural Pacific Northwest	All patients seen by PA	90%
Watkins, 1978 (unpublished)	1977	Emergency department of an institution	200,000 health plan members	Triaged appropriate patients to PA	45%
Ott[13]	1975	Solo & group	9 practice settings	Receptionist to child health associates	99%
Ekwo[63]	1977–78	Solo, group & satellite	19 primary care practices in Iowa	Receptionist and independent	87%, 87% (satellite)
Weiner[64]	1975	3 HMOs	More than 300,000 health plan members	Varied by health plan	47% 15% 6%

tial PA utilization model was an individual physician practice, most PA productivity studies have tried to determine the best practice arrangements for PAs in that setting. One model estimated that a PA could increase medical practice productivity from 49% to 74%. In other words, a physician who usually handles 147 patient office visits per week could increase that number to at least 219 simply by hiring a PA.

Nelson et al found that when PA providers were studied in solo and small group medical practices, practice productivity, as measured by number of office visits, was increased by 12% during the first year and 37% during the second year.[20]

Reinhardt found that physicians in group practices could manage more patient care visits than those working in solo practices. He noted that medical care services delivered by groups of physicians exhibited clear economies of scale.[21] Measures of PA productivity in the HMO setting, where economies of scale are often quite large, are consistent with findings observed in studies of rural private practices, urban ambulatory care clinics, and geriatric settings.[22,23]

DELEGATION

Delegation is defined as the percentage of medical responsibilities that can be safely handled by a PA under optimal conditions. A panel of experts typically derives this percentage using a set of criteria. The term *delegability* was coined by Record et al to refer to the maximum level of delegation that can be achieved without threat to quality of care.[6]

A review of the literature examining delegation identified 10 studies that used office visits as an output measure (see Table 1). In the aggregate, the range of delegation is extremely broad—6% to 99%—with considerable overlap across different settings.

In one study, a multidisciplinary panel of health professionals at Kaiser Permanente developed a set of medical principles focusing on the patient's complaint and medical history. The study panel examined an outpatient use database for 1 year to identify the office visits that would have been assigned to PAs under the panel's medical criteria. The study group decided that significant illnesses, such as cancer, renal failure, congestive heart failure, and progressive illnesses, would be triaged away from PAs; all patients could choose to be seen by a physician or a PA at time of appointment; and no patient would be seen consecutively more than twice for the same diagnosis by a PA. PAs and physicians were assigned an equal number of appointments each day.

The outcome was that 83% of all patients seen in primary care by physicians could be managed safely by a PA without physician supervision.[24] No other study has been as rigorous, included as many physicians and PAs, or examined as many encounters (in terms of diversity and number).

Large practices, such as group and staff model HMOs, the Veterans Administration and military and correctional facilities, seem more likely to employ PAs and nurse practitioners (NPs) and deploy a larger percentage of medical services. The positive correlation of size and delegation is further supported by a study of primary care teams. This study found a 24% greater delegation of technical tasks for PAs and NPs and a 6% greater delegation of patient care tasks in large medical organizations than in small office-based practices.[25]

Knickman et al conducted a time-motion study analyzing the delegatability of clinical tasks at 2 New York City hospitals. He used 2 different models: a traditional model, in which the resident physician is the primary medical manager, and an alternative model, in which a PA or NP performs baseline patient care monitoring. In the traditional model, residents spent almost half of their time on tasks that they could not delegate. With the alternative practice model, however, 80% of the resident's time was delegable.[26]

A 1995 survey of 144 teaching hospitals found that 60% reported similar experiences with PAs or NPs and residents in their hospitals as the Knickman study. In addition, one third of the hospital departments planned to increase PA and NP use.[27]

CONSULTATION

Consultation occurs when a PA requests a physician's assistance during a specific office visit. Many circumstances determine the rate of consultation, and the request can take many forms, with varying time and cost usage. Signing a prescription, verifying a radiographic finding, or approving a proposed management plan may take the physician only a minute or two; a complicated case may take more time.

Consulting with the PA can decrease the time the physician has for his or her own tasks, as well as overall productivity. In the few states that inhibit full PA prescribing or dispensing, the PA may have to consult with the physician on every patient who neds a prescription.

The *consultation rate* is the number of consultations of any kind over the total number of visits assigned to the PA in a given time period. The rate may be closely related to the level of delegation in a certain specialty or by a specific physician. Therefore, the consultation rate and delegation level are important in cost-effectiveness analysis.

Because consultations are often informal, little is known about the PA consultation rate. The consultation rate is probably higher for inexperienced PAs, though many variables undoubtedly control this rate, such as relationship with the physician, time, availability, and patient mix. Time-motion studies

Continued on page 57 ▶

◀ Continued from page 54

Table 2
PHYSICIAN SURVEY MEAN RESPONSES TO QUESTIONS ON SUPERVISION OF PAs AND NPs

	Physician Who Supervises PA (n=75)*	Physician Who Supervises NP (n=34)*
Hours/week physician spends in direct care	33.0	29.7
Hours/week physician supervises PA/NP	16.1	9.2
Percentage of time PA/NP takes first call for physician	20.2%	26.4%
Percentage of time supervision involves:		
Overseeing medical procedures	23.7%	27.2%
Checking orders with PA/NP	25.7%	41.5%
Other activities	50.6%	31.3%

Source: Alexander 1992.[28]
*Number of responding physicians

are needed documenting every minute of the physician–PA relationship over a prolonged period of time in order to understand the importance of this labor assessment.

SUPERVISION

Supervision is a state-legislated term used as the basis for legitimizing the PA profession. Competent supervision is needed to ensure patient care quality, but it can restrict delegated tasks and decrease productivity. The amount of time devoted to supervision depends largely on the relationship between the PA and the physician, but little study has been devoted to this important function.

In 1992, the Veterans Administration surveyed more than 100 physicians who supervise PAs and NPs.[28] In this study, the time spent supervising a PA or NP was 9.2 to 16.1 hours/week, based on a work week of approximately 30 hours of direct patient care (Table 2). In addition to supervising the PA or NP, the physicians also provided direct patient care, usually in the same setting; therefore, the actual amount of time spent in direct supervision is not known.

A large HMO that employed both PAs and NPs decreased the supervising physician's patient load by 10% per day. This percentage was designated as administrative time and inserted into the schedule to compensate the physician for supervising and reviewing medical records.[29]

CLINICAL PRODUCTIVITY

In medical economics, productivity is the number of patients seen hourly, daily, or annually. The noted economist Jane Record defined productivity, "In theory, productivity is a simple concept: it measures changes in the total output that occur when small changes are made in one factor of production, with all other factors and circumstances held constant. Because these conditions can be met in the real world only rarely, productivity numbers are almost always rough estimates. Certainly that is the case with respect to PAs."[6]

Record divided productivity into 3 categories: (1) the comparative time taken by physicians and PAs to handle an office visit; (2) the comparative output of physicians and PAs in patient office visits per year; and (3) the effect of a PA on the output (revenue) of a practice.

One study found that PAs and NPs averaged 17.1 minutes per visit while the physicians averaged 11.1 minutes. The protocol followed by PAs and NPs accounted for much of the time difference, with NPs varying more widely than physicians and PAs.[3] In another study, PAs averaged 7.1 minutes per routine office visit while physicians averaged 8.9 minutes. Interestingly, medical record reviews indicated the physicians tend to have older patients with a greater number of comorbidities, accounting for some of the time disparity.[6]

In virtually every productivity study, PAs compare favorably with physicians.[10,30] In fact, evidence exists that PAs see more patients per unit time than do physicians in some settings.[19,31]

PA productivity can be compared with physician productivity in 2 additional ways: (1) on the basis of tasks PAs are qualified to perform, and (2) on the

Table 3
PA CLINICAL PRODUCTIVITY IN AN HMO SETTING

Department	Patients/Hour	Patients/Day
Family practice		
Physicians	2.39	17.4
Physician assistants	2.61	19.0
Internal medicine		
Physicians	3.10	22.5
Physician assistants	2.97	21.5
Pediatrics		
Physicians	3.14	16.5
Physician assistants	3.07	22.3

Source: Hooker 1993[19]

full range of tasks performed by a physician. This latter comparison is sometimes known as *functional delegation*.[32]

One study compared 9 medical practices that employed PAs with control practices. Researchers found that clinical productivity increased by 40.4% (measured by number of office visits) for the physician–PA practices as compared to 1.3% during the same time period for the control practices.[33] A study assessing the impact on use of physician time in small practices employing PAs found that, with PAs in the practice, physicians spent a larger proportion of time communicating with patients, and seeing patients who were older, more seriously ill, or hospitalized.[34]

A small-scale cost-effectiveness study evaluated the performance of 4 PA/NP providers and 5 family practice physicians, comparing practice costs for both provider types working in a student health clinic (a type of prepaid system) and in a fee-for-service family practice clinic. Researchers compiled total hours worked, number of patients seen, revenue generated, and provider salaries for the 9 primary care providers over a 49-week period. In the student health clinic, the average cost for salaries for each patient visit was $5.49 for PAs and NPs and $8.53 for physicians. In the family practice clinic, revenue generated per salary dollar was $2.68 for PAs and NPs versus $2.62 for family physicians.[35]

Mathematical models have been developed to explore the most efficient contribution of health care personnel in different settings, including private group practices, urban medical centers, military settings, managed health care settings,[2,19,36-40] and tertiary centers.[41] These models provide theoretical documentation of PA productivity, with estimates ranging from 50% to 95% of physician productivity.

This author studied hourly, daily, and annual productivity of PAs, NPs, and physicians in primary care, composed of internal medicine, family practice, and pediatrics, in a large HMO. The study showed that PAs saw more patients than physicians in the same amount of time (29% annually). This difference is partly due to PAs being primarily outpatient-based and physicians having hospital responsibilities away from the medical office (Table 3). Patient visits to physicians and PAs were similar in 90% of the cases in terms of conditions seen (the functional delegation level).[31]

Physicians and PAs both saw patients with commonly occuring conditions, such as upper respiratory infections, trauma, hypertension, diabetes, and pregnancy, and to give immunizations. They differed, however, in the severity of illnesses. For example, physicians saw more patients with acute cardiac illnesses, cerebral accidents, and cancers.[19]

Although some practices employ PAs to meet in-

Table 4
PHYSICIAN PRODUCTIVITY WHEN A PA IS ADDED TO THE CLINIC

Study Year	PA–Physician Ratio	Percent Productivity
Greenfield (1978)[3]	1:1	92.0%
Cyr (1985)[39]	1:1	80.1%
Hooker (1993)[19]	1:2	110.0%

Note: Productivity is the percentage of patients seen in an outpatient setting when a PA is added compared with a physician's average patient load.

creasing demand, others employ PAs to relieve physicians of excessive workloads.[42] Kane noted that after hiring PAs, more patients in the practice were seen by appointment and had specific plans for follow-up.[43] Other researchers reached similar findings (Table 4).

Studies of PA clinical productivity in newer practice areas, such as inpatient hospital settings and non–primary care have not been performed. In addition, the content of clinical care—specific medical tasks—delivered by PAs differs within various clinical settings.

The population base is a difficult variable to control in comparing PA productivity in different settings. Differences also exist among groups of PAs regarding work setting, type of specialty, and years of experience. Using data collected in the 1995 American Academy of Physician Assistants (AAPA) Membership Census, the AAPA Research Division examined the number of outpatient visits per day for PAs, controlling for a number of variables. Tables 5, 6, and 7 present summary productivity statistics for PAs defined by work setting, years of experience, and field of practice. All data were for PAs in full-time clinical practice who worked for 1 employer.[44]

This study of more than 3000 PAs found a statistically significant difference in the number of outpatients seen per day by work setting, with the largest difference reflected by PAs who were self-employed. PAs with more experience see more patients per day. The greatest number of patients seen per day was in the emergency medicine and pediatric departments, where PAs reported seeing more than 24 patients per day.

On average, PAs saw 21.7 outpatients per day. Most PAs reported working about 40 hours per week, PAs in inner city clinics reported fewer hours per week, and PAs in military facilities reported more hours per week than in all other settings.[44]

Table 5
MEAN AND STANDARD DEVIATION OF OUTPATIENTS PER DAY BY WORK SETTING FOR PHYSICIAN ASSISTANTS, 1995

Setting	Respondents	Mean	SD
Clinic	763	21.9	9.6
Group practice	517	21.6	7.7
Solo practice	190	22.7	9.9
HMO	198	21.3	6.2
Other managed care organization	19	20.1	7.0
University hospital	72	15.0	13.1
Hospital (nonuniversity)	260	23.7	10.7
Inner city clinic	116	19.9	12.2
Military facility	248	24.8	8.3
Corrections facility	51	23.7	12.4
Nursing home	5	19.4	4.7
Rural clinic	357	20.2	8.9
Self-employed PA	10	35.9	14.5
VA facility	58	16.6	5.5
Industrial facility	44	20.1	9.3
Academic facility	33	22.4	7.9
Public health facility	27	21.0	6.8
Other government facility	14	23.4	20.6
Other clinical setting	109	20.7	10.6
Total	**3091**	**21.7**	**9.5**

Source: American Academy of Physician Assistants, Research Division, 1996.
Note: Based on PAs reporting outpatient visits but no inpatient or nursing home visits. Data collected from the 1995 AAPA Member Census.

COSTS

PA costs can be viewed from 2 perspectives. An entrepreneurial concern is whether the increase in practice revenue from an additional provider will exceed the costs of adding that provider, and whether hiring a physician or a PA is more desirable. The societal concern is how to deliver high-quality care at minimum cost. According to this public policy view, all health care costs are ultimately borne by society.

Employment Cost of PAs

Costs to be considered in PA employment include salary, benefits, malpractice insurance, office space, equipment, support staff, and supplies. Overhead

Table 6
MEAN AND STANDARD DEVIATION OF OUTPATIENT VISITS PER DAY BY YEARS OF EXPERIENCE

Experience (Years)	Respondents	Mean	SD
<1	139	18.6	7.2
1–3	821	20.8	8.8
4–6	505	21.9	10.1
7–9	341	21.2	8.5
10–12	410	21.6	8.6
13–15	371	22.5	10.2
16–18	343	22.8	10.5
>18	296	23.3	10.3
Total	**3226**	**21.7**	**9.4**

Source: American Academy of Physician Assistants, Research Division, 1996.
Note: Based on PAs reporting outpatient visits but no inpatient or nursing home visits. Data collected from the 1995 AAPA Member Census.

costs, other than compensation, differ little between PAs and physicians.

Kane examined practice finances before and after the employment of a formally trained PA. No significant changes in patient volume were noted; however, practices that employed a PA showed an increase in revenue and net profit per physician. On average, net profit increased approximately 22% for physicians with a PA and 12% for control physicians. Researchers also observed a change in activity for the employing physicians: The physicians associated with PAs were relieved of some primary care responsibilities and were able to pursue activities that required greater skill and generated more revenue.[43] This meant more remuneration for less time, suggesting indirect financial benefit from the addition of a PA.

The income differential between PAs and physicians is large. Based on national data published by the AAPA in 1999, the average salary for an experienced primary care PA was $60,000. The average PCP that year earned approximately $136,000,[45] placing the PA's salary at .44% of the salary of the PCP.

Finally, although liability data are difficult to find, anecdotal reports suggest that malpractice insurance is less expensive for the PA because their litigation rate is less than physicians.[46] Malpractice claims provide an estimate of the safety of PA practice. Data for the National Practitioner Data Bank reveal that PAs have approximately one third the malpractice claims per capita than physicians over an 8-year period.

Compensation-to-Production Ratio

The net value of a PA can be determined by comparing compensation (salary and benefits) with revenue generated. A useful ratio is the amount of compensation expended to retain the PA divided by the amount of revenue the PA generates. The smaller the ratio, the more economical the provider is to the practice. The Medical Group Management Association collects these data annually (Table 8). In 1998, the compensation-to-production ratio for PAs was .38. For every dollar in revenue generated, the employer spent $.38 to employ the PA. By comparison, the ratio was .44 for family practice physicians, .40 for pediatricians, .41 for NPs, and .48 for psychologists, suggesting that PAs are more economical to employ than other types of health care providers.[48] Although the number of providers used for this study was not large, the relative ratios indicate that PAs increase practice efficiency more than most other types of providers.

Education Costs

The cost of education for PAs is less than the cost for physicians (at least for allopathic physicians). The cost of educating PAs, as with virtually all other health care professionals, has been borne largely by society through grants to institutions and tuition subsidies for students and trainees. A student's personal costs are tuition, books, and lost income. For physicians, the 3 training-cost components are medical school costs, graduate (resident) training costs, and opportunity costs. Because virtually no physician begins practice after graduation, we must consider medical training as 7 years—4 years of medical school and 3 years of postgraduate training (residency). The PA education track is an average of 25 months.[45]

The average PA student has a baccalaureate degree, as does the medical student.[45] They both have

Continued on page 63 ▶

◀ Continued from page 60

Table 7
MEAN AND STANDARD DEVIATION OF OUTPATIENT VISITS PER DAY BY FIELD OF PRACTICE

Field of Practice	Respondents	Mean	SD
Family/General medicine	1836	22.1	8.2
General internal medicine	255	18.9	8.6
General pediatrics	115	24.4	9.9
Emergency medicine	316	24.6	11.2
General surgery	6	18.3	7.3
IM specialties	130	16.8	13.6
Pediatric specialties	33	18.7	15.1
Surgical specialties	145	20.0	10.6
OB/Gyn	88	20.0	10.4
Industrial/Occupational medicine	181	21.7	10.3
Other	173	21.4	10.6
Total	**3278**	**21.7**	**9.6**

Source: American Academy of Physician Assistants, Research Division, 1996.
Note: Based on PAs reporting outpatient visits but no inpatient or nursing home visits. Data collected from the 1995 AAPA Member Census.

similar backgrounds with varying combinations of academic coursework in their undergraduate years. Given the overlapping training periods for physicians and PAs, the opportunity costs (foregone years of practice) for physicians and PAs can be calculated. As shown in Table 9, PAs and medical students are assumed to begin professional education after four years of college work.

The physician becomes fully productive after 7 years—5 years later than the PA. Assuming that a provider is valued by salary level and that the average PA salary is $60,000, the PA has delivered $300,000 ($60,000 × 5 years) worth of care to society before the physician begins practice. This figure is defined as the *opportunity cost* of additional medical education and training. This is also the value of health care that would have been delivered had the medical student begun to provide care sooner.

If direct training costs are approximately $20,000 for a PA spread over 2.1 years[49] and $100,000 for a primary care physician over 4 years, the difference in education costs between the physician and PA may be calculated as $100,000 minus $20,000, plus the protracted training of a residency ($100,000 - $20,000 + $300,000). The differential is nearly $380,000 (1999) dollars per PA. Thus, a PA produces $380,000 worth of patient care before a physician begins practice.

This calculation is expected to generate some criticism. The costs are approximate, although these are considered conservative assumptions. Average salaries are not the same as starting salaries, and because reaching each provider's average earnings potential will take varying amounts of time, the value of each provider may be overstated. The value of service a resident physician produces is offset by the added suport of the resident's training. Also, the cost of osteopathic training (a cost reported to be lower than allopathic training) was not factored.[50] Regardless, these calculations illustrate the differences expected from each type of education track.

If salary costs are used as a proxy for employment costs, the physician/PA differential is $76,000 (the difference between average salaries of $136,000 for primary care physicians and $60,000 for primary care PAs). Therefore, the salary cost of a PA is 44% that of a physician. If the practice arrangement requires 10% of a physician's time to supervise a PA, 10% of $136,000 should be added to the cost of employing a PA. The PA/MD cost ratio would then become $73,600/$136,000, or 54%. When Record made these calculations using 1977 data, the cost ratio of hiring a PA was .38, based on a wider disparity between PA and physician salaries.[6] Since that time, salaries for PAs and physicians have steadily climbed.[45]

Substitution Ratio

The physician/PA substitution ratio is the amount of physician services a PA can provide. This is determined primarily by the level of delegation and by comparing productivity of physicians and PAs for a range of health care services. A substitution ratio of 1.0 implies unity and is achieved when 1 PA substitutes for 1 physician. PAs in rural and isolated

Table 8
COMPENSATION-TO-PRODUCTION RATIO FOR PHYSICIAN ASSISTANTS

	# Providers	Medical Practices	Mean
Overall for PAs:	124	40	.381
Organization type:			
Single specialty	19	13	.433
Multispecialty	105	27	.372
Other providers:			
Family practice physician	1117	135	.447
Internal medicine physician	883	134	.447
Pediatric physician	501	107	.409
Nurse practitioner	71	31	.419
Midwife	15	7	.472
Optometrist	57	20	.423
Psychologist	104	32	.477
Podiatrist	31	19	.334

Source: Medical Group Management Association, 1998.

clinics usually function at very high levels, often replacing a physician previously occupying the role.[51] Little is known, however, about the types of patients, the number of annual patient visits, or how current patients compare with patients managed by the physician.

Using an urban health center as a paradigm, one study conservatively estimated that a PA could replace at least half of a full-time physician. From data developed in a national survey of physicians, Scheffler estimated that a 10% increase in the medical office visits output of a practice would require an average increase of 3.5% in physician hours or 5.4% in PA hours.[16] These figures suggest a marginal substitution ratio of .63, as compared with the overall .50 ratio estimated by Zechauser and Eliastom.[38] Another mathematical model used data from 7 HMOs to demonstrate the potential impact of PAs and NPs on physician requirements and found that, in adult medicine, the addition of 12.7 PAs and NPs would permit the number of physicians to drop from 16.4 to 9.7. Thus, the 12.7 PA/NPs could replace 5.7 physicians.[2] The substitution ratios were calculated as .45.

Record's large study, which controlled for variables such as types of patients and settings, determined that if PAs were hired by physicians to perform services in the Department of Internal Medicine at Kaiser Permanente, and if the PA and physician work weeks were equal, the substitution ratio would be at least .76.[32] Although this study was conducted in 1978, 76% has generally become the industry standard.

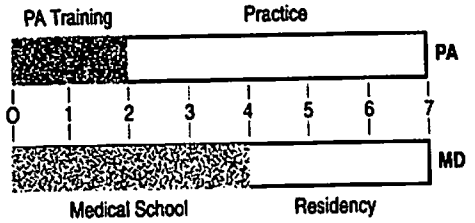
Steinwachs et al studied ambulatory care in another HMO and found the substitution ratio to be .38 in adult care and .48 in pediatrics.[52] The figures might have been higher if the setting had been primary care, as it was in the Record study, with outpatient specialty services excluded. Hooker developed data that suggest the ratio was .90[19] and Page's research in the military was close to unity (1 to 1) as early as 1975.[18] Most of the estimates of substitution ratios fall near .75. For practice managers, this ratio suggests that 4 PAs could replace 3 physicians. Whether these estimates would be the same in a contemporary managed care setting remains to be seen.

Cost-Benefit Analysis

Cost-benefit analysis examines whether there is any benefit to a new input not ordinarily accounted for in cost-effective analysis. To ascertain if using PAs in acute primary care settings is cost-beneficial to an employer, electronic medical records data used in 1997 by a large HMO were examined for all aspects of an episode of care. Variables included provider type (PA or physician), diagnosis, medication, procedures, imaging, laboratory studies, patient health status, and return visits. Four acute medical conditions seen by PAs or physicians were assigned internal or allocation costs. A multivariate analysis identified significant cost differences in each cohort of patients seen by physicians or PAs in the internal medicine, family practice, and pediatrics departments. Analysis of variance determined which patient variables—age, gender, and health status—were most significant.

In every medical condition, the total episode cost

Table 9
COST COMPARISON OF PHYSICIAN ASSISTANT AND PHYSICIAN TRAINING PROGRAMS



	PA Student	Medical Student
Cost/Year	$10,000	$25,000
Years of Training	2	4
Total	$20,000	$100,000

Note: Cost comparison of PA and physician training programs in 1997 dollars.
Source: Adapted from Record, 1980.

for PAs was less than a similar episode cost managed by a physician, regardless of patient age, gender, health status, and provider department. No differences were seen in the rate of return visits between physicians and PAs when types of patients were held constant. In some instances, the use of resources was less for PAs. The author concluded that, in this setting, PAs are not only cost-effective but also cost-beneficial from a standpoint of employment.[53]

SUMMARY

It appears that PAs can safely assume at least 83% of all outpatient primary care visits without supervision. But how cost-effective is a PA? While not known precisely, the answer is contained in the difference between the physician/PA substitution ratio (.75) and the physician/PA cost ratio (.44). These numbers indicate that a PA can substitute for at least 75% of a PCP's services at approximately 44% of the physician's direct cost in salary. If the physi-

Table 10
COST-EFFECTIVENESS OF PRIMARY CARE PHYSICIAN ASSISTANTS

Issue Examined	Range	Average or Best Study
	.10 .25 .50 .75 1.00	
Delegation		.83
Supervision		.10
PA/Physician Substitution Ratio		.75
PA/Physician Cost Ratio (salary)		.44
PA/Physician Cost Ratio (with supervision)		.53
Compensation-to-Production Ratio		.38
Societal Cost Training a PA (compared with a physician)		.20
Average number of outpatients seen	18 to 35	21.7
PA/Physician Cost-Benefit Ratio	unknown	unknown

Note: Based on a review of the literature up to 2000, using conservative estimates, and extrapolating to 1999 costs.

cian's time is reduced because of PA supervision, the employment cost of a PA is 53% of a physician's cost.

The social cost figures are even more impressive because the PA/physician ratio, including education costs, is smaller than the employment cost ratio, which means that educating a PA is more cost-effective than educating a physician. Finally, the employment of a PA is economical because the compensation-to-production ratio (.38) is more efficient than for most other types of provider.

Analysis of episodes of care shows that the PA does not negate the salary differential and may be more economical in the use of resources (at least for acute primary care conditions). See Table 10 for a summary of the economic exercises.

These figures must be viewed with caution. They are the author's opinion based on the studies considered the most rigorous in investigation or on the average of different studies, using fairly conservative figures. However, many of the studies use small numbers that may not be statistically significant and many of the estimates were derived from studies conducted before 1980.

CONCLUSION

In addition to the studies presented, the fact that in the year 2000 more than 35,000 PAs are employed is significant empirical evidence for cost-effectiveness. Employers—physicians, federal agencies, clinics, and hospitals—would not employ PAs if they were not, to some degree, cost-effective, much less cost-beneficial. Economic analyses of PAs indicate that PAs (and other nonphysician health care providers) appear to be underutilized in their roles in medical care. The potential for PAs to fully contribute to health care delivery is largely inhibited by physicians' attitudes, inconsistent state laws, and irregular reimbursement policies.[54-56]

Theoretical projections of the cost savings that could accrue under optimal conditions of nonphysician provider utilization are considerable. For NPs, estimates of $4 to $5 billion annually have been made.[57,58] If the efficiencies for PA employment are as good as for NP employment, this benefit to society is substantial.

REFERENCES

1. Office of Technology Assessment, US Congress. Nurse Practitioners, Physician Assistants, and Certified Nurse Midwives: A Policy Analysis. Case Study #37, OTA-HCS-37, Washington, DC: Government Printing Office, December 1986.
2. Schneider DP, Foley WJ. A systems analysis of the impact of physician extenders on medical cost and manpower requirements. *Med Care.* 1977;15(4):277-297.
3. Greenfield S, Komaroff AL, Pass TM, et al. Efficiency and cost of primary care by nurses and physician assistants. *N Engl J Med.* 1978;29,8(6):305-309.
4. McCibbin R. Cost effectiveness of physician assistants: A review of recent evidence. *PA.* 1978;8(2):110-115.
5. Cawley JF. *The Cost Effectiveness of Physician Assistants.* Alexandria, VA: American Academy of Physician Assistants, 1986.
6. Record JC, McCally M, Schweitzer SO, et al. New health professions after a decade and a half: delegation, productivity, and costs in primary care. *J Health Polit Policy Law.* 1980;5(3):470-497.
7. Romm. J, Berkowitz A, Cohen MA, et al. The physician extender reimbursement experiment. *J Amb Care Manage.* 1979;2(2):1-12.
8. Spitzer WO. The nurse practitioner revisited: slow death of a good idea. *New Engl J Med.* 1984;310(16):1049-1051.
9. *Progress and Problems in Training and Use of Assistants to Primary Care Physicians.* Publication No MWD 75-35. Department of Health, Education, and Welfare: Report to the Congress by the Comptroller General of the United States, April 8, 1975.
10. Scheffler RM, Waitzman NJ, Hillman JM. The productivity of physician assistants and nurse practitioners and health work force policy in the era of managed health care. *J Allied Health.* 1996;25(3):207-217.
11. Feldstein PJ. Health associations and the legislative process. In Litman TJ, Robins LS editors. *Health Politics and Policy;* 2nd edition. Albany, NY: Delmar Publishers, Inc. 1991.
12. Sox HC Jr. Quality of patient care by nurse practitioners and physician's assistants: a ten-year perspective. *Ann Intern Med.* 1979;91(3): 459-468.
13. Ott JE. A Demonstration Project on the Education and Utilization of Child Health Associates and Their Impact on Medical Practice, Executive Summary. 1979. Division of Medicine, CT #231-75-0006.
14. Mendenhall RC, Repicky PA, Neville RE. Assessing the utilization and productivity of nurse practitioners and physician's assistants: methodology and findings on productivity. *Med Care* 1980;18(6):609-623.
15. Johnson RE, Freeborn DK, McCally M. Delegation of office visits in primary care to PAs and NPs: the physicians' view. *Physician Assist.* 1985;9(I):159-160, 165-169.
16. Scheffler RM. The productivity of new health professionals: physician assistants and Medex. *Research Health Econ.* 1979;1:37-56.
17. Tirado NC, Guzman M, Burgos FL. Workload contribution of a physician assistant in an ambulatory care setting. *PR Health Sci J.* 1990; 9(2):165-7.
18. Page RR. The Military Physician's Assistant 1975. DD Health Studies Task Force, Office of the Assistant Secretary of Defense (Health and Environment), Study File 7.4.5 DASD (HA).
19. Hooker RS. The roles of physician assistants and nurse practitioners in a managed care organization. In Clawson DK, Osterweis M, editors. *Roles of Physician Assistants and Nurse Practitioners in Primary Care.* Association of Academic Health Centers, 1993. Washington, DC.
20. Nelson EC, Jacobs AR, Breer PE, et al. Impact of physician's assistants on patient visits in ambulatory care practices. *Ann Intern Med.* 1975;82(5):608-612.
21. Reinhardt UE. A production function for physician services. *Rev Econ Stat.* 1972;54:55-66.
22. Hansen JP, Stinson JA, Herpok FJ. Cost effectiveness of physician extenders as compared to family physicians in a university health clinic *J Am Coll Health Assoc* 1980:28(4):211-214.
23. Frick, JC. Physician assistants as house officers: our experience. *Physician Assistant.* 1983;7(4):13, 16.

Continued on page 71 ▶

◀ Continued from page 66

24. Record JC. Cost Effectiveness of Physician Assistants in a Maximum-Substitution Model: Final Report: Phase II of a Two-Phase Study. Contract No. 231-76-0601. DHEW Publication No. (HRA) 78-1. Hyattsville, MD: US Dept of Health, Education, and Welfare, Public Health Service, Health Resources Administration, Bureau of Health Manpower, Division of Medicine. 1978.
25. Breslau N, Novack AH, Wolf G. Work settings and job satisfaction: a study of primary care physicians and paramedical personnel. *Med Care.* 1978;16(10):850-862.
26. Knickman JR, Lipkin M Jr., Finkler SA, et al. The potential for using nonphysicians to compensate for the reduced availability of residents. *Acad Med.* 1992;67(7):429-438.
27. Riportella-Muller R, Libby D, Kindig D. The substitution of physician assistants and nurse practitioners for physician residents in teaching hospitals. *Health Aff (Millwood).* 1995;14(2):181-191.
28. Alexander BJ, Lipscomb J. Nonphysician Practitioners Panel Report. In Lipscomb & BJ Alexander, editors. Physician Staffing for the VA: Volume II, Supplementary Papers. Washington, DC: National Academy Press. 1992. 421-465.
29. Hooker RS, Freeborn DK. Use of physician assistants in a managed health care system. *Public Health Rep.* 1991;106(1):90-94.
30. Crandall LA, Santulli WP, Radelet ML, et al. Physician assistants in primary care: patient assignment and task delegation. *Med Care.* 1984; 22(3):268-282.
31. Hooker RS. Medical care utilization: MD-PA/NP Comparisons in an HMO. In: Zarbock SF, Harbert K. editors. *Physician Assistants: Present and Future Models of Utilization.* New York: Praeger Publishers. 1986.
32. Record JC. The productivity of new health practitoners. In Record JC. *Staffing Primary Care in 1990: Physician Replacement and Cost Savings.* New York: Springer Pub Co. 1981.
33. Smith KR. *Health Practitioners: Efficient Utilization and the Cost of Health Care.* Madison: Department of Economics, University of Wisconsin, 1973.
34. Nelson EC, Johnson KG, Jacobs AR. Impact of Medex on physician activities: Redistribution of physician time after incorporating a Medex into the practice. *J Fam Pract.* 1977;5(4):607-612.
35. Hansen JP, Stinson JA, Herpok FJ. Cost effectiveness of physician extenders as compared to family physicians in a university health clinic. *J Am Coll Health Assoc.* 1980;28(4):211-214.
36. Golladay FL, Smith KR, Davenport EJ, et al. Policy planning for the mid-level health workers: economic potentials and barriers to change. *Inquiry.* 1976;13(1):80-89.
37. Golladay FL, Miller M, Smith KR. Allied health manpower strategies: estimates of the potential gains from efficient task delegation. *Med Care* 1973;11(6):457-469.
38. Zechauser R, Eliastam M. The productivity potential of the physician assistant. *J Human Resour.* 1974;9(1):95-116.
39. Cyr KA. Physician-PA practice in a military clinic: A statistical comparison of productivity and availability. *Physician Assist.* 1985;9(4):112-113, 119, 123-124.
40. Ortiz L. The role of PAs in Alaskan Air Command. *Air Force Medical Service Digest.* November-December 1979;6-7.
41. Harbert K, Shipman RA, Conrad W. The utilization of physician extenders, Midlevel providers in a large group practice within a tertiary health care setting. *Medl Group Manage J..* 1994;41(6):26, 28, 49-50 passim.
42. Jacobson P, Parker LE, Coulter ID 1998. Nurse pracitioners and Physician assistants as primary care providers in institutional settings. *Inquiry.* 35, 432-446.
43. Kane RL, Olsen DM, Castle CH. Effects of adding a Medex on practice costs and productivity. *J Community Health* 1978;3(3):216-226.
44. American Academy of Physician Assistants. General Census Data on Physician Assistants: 1995. Alexandria, VA 1996.
45. Simon CF, Born, PH. Physician earnings in a changing managed care environment. *Health Aff (Millwood).* 1996;15(3):124-133.
46. Wolman D, Madden JF. Increasing utilization of PAs in the emergency department. *Physician Assist.* 1996;20(11):108,111,115-116.
47. Cawley JF, Rohrs RC, Hooker RS. Physician assistants and malpractice risk: findings from the National Practitioner Data Bank. *Journal Federation of Medicine.* 1998;85(4):242-247.
48. Medical Group Management Association. Physician Compensation and Production Survey: 1999 Report Based on 1998 Data. Englewood, CO. 1995.
49. Simon A, Link M, Miko A. Twelth Annual Report on Physician Assistant Educational Programs in the United States, 1995-96. Association of Physician Assistant Programs, Alexandria, VA. 1996.
50. Sirica CM (editor). Current Challenges to MDs and DOs. Proceedings of a Conference. Josiah Macy Foundation, New York, NY. 1996.
51. DeBarth K. Outer Banks, PA: medicine at the edge. *Clinician Reviews.* 1996;6(7):148-158.
52. Steinwachs DM, Shapiro S, Yaffe R, et al. The role of new health practitioners in a prepaid group practice: changes in the distribution of ambulatory care between physician and nonphysician providers of care. *Med Care.* 1976;14(2):95-120.
53. Hooker RS. *Cost-Benefit Analysis of Physician Assistants.* Doctoral Dissertation. Portland State University. Portland, OR. 1999.
54. Safriet B. Health care dollars and regulatory sense: the role of advanced practice nursing. *Yale J Regulation.* 1992;419-486.
55. Sekscenski ES, Sansom S, Bazell C, et al. State practice environments and the supply of physician assistants, nurse practitioners, and certified nurse-midwives. *N Engl J Med.* 1994;331(19):1266-1271.
56. Hooker RS. PAs and NPs in HMOs. *HMO Pract.* 1994;8(4):148-150.
57. Salcido R, Fisher SB, Reinstein L, Willis JB. Underutilization of physician assistants in physical medicine and rehabilitation. *Arch Phys Med Rehab.* 1993;74:826-829.
58. Nichols LM. Estimating costs of underusing advanced practice nurses. *Nurs Econ.* 1992;10(5):343-345, 348-351.
59. Pondy LR, Jones JM, Braun JA. Utilization and productivity of the Duke Physician's Associate. *Socioeconomic Plan Sci* 1973;7:327-52. (See also *PA* 1974:4).
60. Miles DL, Rushing WA. A study of physicians' assistants in a rural setting. *Med Care.* 1976;14(12):987-995.
61. Henry RA. Evaluation of physician's assistants in Gilchrist County, Florida. *Public Health Rep.* 1974;89(5):428-432.
62. Riess J, Lawrence D. *New Practitioners in Remote Practices: Summary of a Study of Training, Utilization, Financing and Provider Satisfaction.* Final report for contract No. 1-MB-44168. Washington, DC: Division of Medicine, Bureau of Health Manpower, Department of Health, Education, and Welfare, 1976.
63. Ekwo E, Daniels M, Oliver D, et al. The physician assistant in rural primary care practices: physician assistant activities and physician supervision at satellite and non-satellite practice sites. *Med Care.* 1979;17(8):787-795.
64. Weiner JP, Steinwachs DM, Williamson JW. Nurse practitioner and physician assistant practices in three HMOs: implications for future US health manpower needs. *Am J Public Health.* 1986;76(5):507-511.

ACKNOWLEDGMENTS

The author is greateful to James F. Cawley, PA, MPH, for his input and advice and to Donna Lux Hooker, Sarah Zarbock, PA, and Jim Baranowski for their critical editing.