



Efficiency and Cost of Primary Care by Nurses and Physician Assistants

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SPECIAL ARTICLE

EFFICIENCY AND COST OF PRIMARY CARE BY NURSES AND PHYSICIAN ASSISTANTS

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Abstract We conducted a prospective study in a prepaid primary-care practice (health-maintenance organization) of a system in which nurses and physician assistants used protocols, and compared the efficiency and costs of this "new-health-practitioner" protocol system to a physician-only nonprotocol system. In five months, we studied 472 patients with any of four common acute complaints — respiratory infections, urinary and vaginal infections, headache, and ab-

dominal pain; a subset of 203 patients was randomly allocated between the two systems. In the new-health-practitioner system physician time per patient was reduced by 92 per cent, from 11.8 to 0.9 minutes, and average visit costs — including practitioner time and charges for laboratory tests and medications — were 20 per cent less ($P = 0.01$). We conclude that this protocol system saves physician time and reduces costs. (*N Engl J Med* 298:305-309, 1978)

THE employment of new health practitioners (NHP's) — nurse practitioners and physician assistants — by health-maintenance organizations (HMO's) has a particular appeal. Because practice income is prepaid, the HMO has a direct incentive to minimize its total salaries. Also, there is no problem of obtaining reimbursement for care given by an NHP, as can occur in fee-for-service practice. On the other hand, if NHP's — as a manifestation of their relative inexperience — were to spend much more time with patients, and order more laboratory tests and medications than physicians would be likely to order, the resulting cost increase would be borne largely by the HMO.

We had the opportunity to work with an HMO that had begun to employ NHP's and wanted to expand their role and evaluate their effect on physician time and system *cost*. On the basis of our past experience,¹⁻¹⁰ we introduced the use of protocols to aid on-site instruction of the NHP's and to encourage conformance with predetermined clinical strategies for ordering laboratory tests and medications. The *quality* of care when NHP's used these protocols had previously been evaluated.^{1,3,5,8-10}

We conducted a prospective study in which patients with any of four common acute-illness symptoms varying in complexity were seen either by a physician only or by an NHP who used a protocol and who could consult with a physician. We measured several elements of the efficiency and cost of care: the time spent with patients by both the NHP and physi-

cians; the time spent by the physician and NHP in consultation about the patient; the cost of laboratory tests and medications generated by the visits; and frequency of related return visits and hospitalizations. The data indicate that an NHP system in which protocols are used is less costly than a physician-only system, and requires considerably less physician time.

METHODS

Setting

The study was conducted at the Southern California Kaiser Permanente Health Facility in Inglewood, California. In this clinic, patients with acute illnesses who telephone for same-day appointments are assigned by the telephone operator to the physicians or NHP's who have available appointment times. Patients who request to see a specific physician or NHP are scheduled with that provider if appointment times are available. In addition, some patients see physicians by appointment for chronic-disease care or screening physical examinations. The population served by the clinic has been described elsewhere.¹¹

During the five-month period of study, seven family physicians, two registered nurses and two physician assistants worked in the clinic. The nurses had not taken a formal university-based nurse-practitioner training program; rather, they had attended an in-service course in general history taking, physical examination skills and management of certain acute and chronic problems. Before the study they had taken responsibility for some diagnostic and therapeutic decisions in the care of patients with acute respiratory infections; the introduction of protocols represented formal criteria for test and medication ordering in patients with these conditions. Before the study, the nurses had not cared for patients with urinary or vaginal infections, headache or abdominal pain; the protocols provided the primary instructional instrument for teaching a clinical decision-making approach to patients with these conditions. The physician assistants were recent graduates of a certified Medex program who found that the protocols organized their theoretical knowledge into a practical approach.

Protocols

As described elsewhere,^{1-10,12,13} a protocol (also called a clinical algorithm) is an instrument that describes appropriate steps to be taken in the diagnosis and management of a particular problem. A protocol for acute illnesses focuses on a specific presenting complaint and indicates appropriate history, physical examination and laboratory data to be obtained. On the basis of clinical and laboratory data obtained, the protocol recommends specific treatment or

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the need for physician consultation. The branching logic of the protocol "individualizes" the data collected and medical actions recommended, according to the patient's clinical picture.

Study Design

Patient selection. Patients with any one of several explicitly identified presenting complaints were scheduled to see a physician or NHP by the telephone operator receiving the call. Patients who saw only a physician constituted what is called here the *MD group*, and were seen in the *MD system*. Patients who saw a NHP using a protocol were part of what is called here the *NHP group*, seen in the *NHP system*. Patients with a particular syndrome are described as being members of the *upper-respiratory-infection subgroup*, *urinary-tract-infection subgroup*, *headache subgroup* or *abdominal-pain subgroup*, respectively.

A completely randomized trial conducted throughout the six-month period of this study would not have been feasible, owing to scheduling constraints. However, we were able to have the telephone operators randomly allocate a 43 per cent subset of patients by the use of sealed random-assignment envelopes. By design, two patients were to be randomly allocated to the NHP group for every one allocated to the MD group, in accord with the clinic's intention to have NHP's manage these common complaints.

On any given day, the same physicians saw patients alone (MD group) and also served as consultants to the NHP's. Depending on the judgment of the NHP and the recommendation of the protocol, a physician might be consulted or the patient might leave without seeing a physician; the NHP would have the physician write any necessary prescriptions. Patients from whom the physician or NHP elicited a presenting complaint different from the complaint recorded by the telephone operator were excluded from the study, as were patients returning for scheduled follow-up care for past illness.

Time studies and record review. All patient visits were timed by a research assistant stationed outside the examination room. She recorded the time spent by the NHP or physician in the examination room with the patient, by NHP and physician in consulting with each other and by a consulting physician with a patient. Physicians were encouraged to allow interruptions by the NHP's for consultations. Generally, NHP time waiting for physician consultation was minimal, and was charged to the NHP.

The records of all patients in the urinary-tract-infection, headache and abdominal-pain subgroups, and of a randomly selected 50 per cent sample of the upper-respiratory-infection subgroup, were reviewed two months after the visit. We noted which laboratory tests and medications had been ordered at the study visit. We also noted return visits, the purpose of such visits and subsequent hospitalizations.

Determination of costs. In each of the four clinical subgroups, the cost of a visit to the NHP group was computed as a function of several direct costs: (average NHP time with patient times NHP cost per unit time), plus (average MD time spent in consultation times MD cost per unit time), plus (average laboratory-test charges generated by a visit), plus (average medication charges generated by a visit).

Laboratory and medication charges are direct costs borne by the Southern California Kaiser Permanente facility, except for a small medication copayment by the patient.

In each of the four clinical subgroups, the cost of a visit to the MD group was computed similarly, with total physician time substituted for the categories listed above: "average physician time spent in consultation" and "average NHP time."

Per-minute salary rates for the physicians and NHP's were calculated on the basis of annual salaries, fringe benefits and hours spent in direct patient care. The weighted average annual salary and fringe benefits for all physicians was \$43,680; it was \$14,950 for the NHP's. Laboratory-test and medication "costs" were calculated according to unit charges reported by the Southern California Kaiser Permanente laboratory and pharmacy.

We calculated an "average visit" figure for provider time, manpower costs, laboratory charges, medication charges, and com-

bined costs (the sum of average visit manpower, laboratory and medication costs). These average-visit figures were weighted averages calculated by use, as weights, of the frequency of each of the four clinical conditions in the total clinic census during the period of the study. The same frequency weightings were used to calculate weighted averages in both the MD group and the NHP group.

We did not include calculations of indirect costs ("overhead") in assessing costs. It should be noted that the formula for determining indirect costs in this setting relied primarily on the total salaries paid to a unit, and secondarily on floor space. Considering the physician and NHP staffing ratios and patient volume served, before and after implementation of the NHP system (as described below in Results), it seems certain that the indirect costs per patient visit are less in the NHP system.

RESULTS

During the study period, there were 690 patient visits in which one of the four clinical syndromes was noted: 434 upper-respiratory-infection, 87 urinary-tract-infection, 66 headache, and 103 abdominal-pain groups. All visits for the urinary-tract infections, headache and abdominal pain, and a randomly selected 216 visits for upper respiratory infections (50 per cent sample) were included in the study, for a total of 472 study visits. Of these visits 203 (43 per cent) were randomly allocated to either the MD group or to the NHP group.

Table 1 compares the four groups (MD random, MD non-random, NHP random, and NHP non-random) for age, sex, time spent by the primary provider with patients and average visit cost. Except for sex, there were no statistically significant differences in any of the characteristics when the randomly and non-randomly allocated patient groups were compared. Because the randomly and non-randomly allocated patients appeared equivalent according to the characteristics considered, we increased the sample sizes in all analyses reported hereafter by combining the randomized and non-randomized patients.

There were no significant differences in time or cost when we compared the performance of the nurse practitioners in the NHP system to that of the physician

Table 1. Characteristics of the Study Population.

CHARACTERISTIC	MD GROUP		NHP GROUP	
	RANDOM	NON-RANDOM	RANDOM	NON-RANDOM
No. of patient visits	55	150	148	119
Mean age (\pm SD)	34.6 \pm 11.8	34.6 \pm 12.4	33.8 \pm 11.0	31.8 \pm 9.2
% male*	28†	60†	45	47
Practitioner time‡ with patient (min)	10.8 \pm 5.7	12.3 \pm 7.7	17.6 \pm 7.3	16.5 \pm 6.5
Average visit cost (\$)‡	17.14	17.06	14.62	12.21

*Excluding patients with symptoms of urinary-tract infection & vaginitis.

†Mean age & % male tested first for significant differences by 4-group comparison. Difference for % male, MD random vs non-random, significant ($P < 0.05$ by chi-square).

‡Time & cost figures tested for significant difference between random & non-random groups, for each practitioner type. We determined average visit practitioner time & average visit cost by weighting the 4 clinical subgroup figures by their frequency in the total clinic census (described in Methods). We tested group differences by 2-tailed t-test for linear contrasts, using the combined within-cell variance; differences were not significant for time & cost.

assistants. Likewise, there were no significant differences in time or cost on those visits (30 per cent of total) when, mainly because of clerical delays in providing the forms, the NHP's did not complete a protocol. These encounters occurred after the initial period during which the NHP's had learned the clinical approaches as described by the protocols.

Clinical subgroup and average visit times spent by both NHP's and physicians in the two different systems are summarized in Table 2. The NHP's averaged four to nine minutes longer, according to the presenting complaints. The physician time required in consultation on the NHP-group patients was 92 per cent less ($P < 0.001$) than the time the same physicians spent dealing with the same clinical problems in the MD group. As shown in Table 3, this reduction in physician time resulted in significantly lower manpower costs for the NHP group, in each of the four clinical subgroups.

Table 2. Mean Physician and Practitioner Time with Patients.

SUBGROUP*	MD GROUP		NHP GROUP		
	NO. OF VISITS	PHYSICIAN TIME (MIN)	NO. OF VISITS	NHP TIME (MIN)	PHYSICIAN CONSULT TIME (MIN)
URI	60	11.4±7.2	156	15.7±6.1	0.8±1.5
UTI	53	11.4±6.2	34	17.4±5.8	0.9±1.2
Headache	32	13.7±8.4	34	19.5±8.3	0.8±1.2
Abdominal pain	60	12.4±7.4	43	21.1±8.3	1.3±2.3
Average visit†		11.8		17.1	0.9

*URI denotes upper respiratory infection, & UTI urinary-tract infection.

†Weighted average calculated & tested for significance as in Table 1. All differences between mean physician time & mean NHP time significant at $P > 0.005$ (by 2-tailed t-test).

Laboratory-test charges per encounter are summarized in Table 3. MD-group physicians generated significantly more laboratory charges than the NHP-group practitioners in the abdominal-pain subgroup; this finding was due primarily to more frequent ordering of various nonradiologic laboratory tests. NHP's generated significantly more laboratory charges in the urinary-tract-infection subgroup because of more frequent ordering of urinalysis and culture, and microscopical examination of vaginal discharge, in compliance with the protocol recommendations.

Medication charges for the two provider groups were not significantly different for any of the clinical subgroups, except for the urinary-tract-infection subgroup (Table 3).

Approximately one third of patients in both the MD and NHP groups made *return visits* for related problems within two months of the initial visit. Two NHP-group patients and two MD-group patients were subsequently *hospitalized* for problems related to their initial clinic visit; one patient in each group had been randomly allocated.

Table 3. Cost Components According to Complaint and Provider Type.

SUBGROUP*	MD GROUP	NHP GROUP	P VALUE†
URI:			
Primary provider time	\$ 5.69 ± 3.52	2.49 ± 1.19	<0.001‡
MD consultation time		0.40 ± 0.72	
Laboratory tests	6.51 ± 11.46	5.53 ± 9.61	NS¶
Medications	2.58 ± 2.26	2.88 ± 2.11	NS
Visit cost‡	14.79 ± 13.14	11.28 ± 10.48	<0.05
UTI:			
Primary provider time	5.39 ± 2.83	2.73 ± 0.88	<0.001‡
MD consultation time		0.36 ± 0.63	
Laboratory tests	13.20 ± 10.71	18.60 ± 10.33	<0.05
Medications	2.47 ± 2.04	3.65 ± 2.32	<0.05
Visit cost	21.07 ± 11.56	25.34 ± 11.07	NS
Headache:			
Primary provider time	6.85 ± 4.12	3.22 ± 1.89	<0.001‡
MD consultation time		0.39 ± 0.65	
Laboratory tests	10.24 ± 15.54	7.56 ± 12.78	NS
Medications	1.66 ± 1.77	1.99 ± 2.03	NS
Visit cost	18.75 ± 15.85	13.17 ± 13.44	NS
Abdominal pain:			
Primary provider time	6.21 ± 3.73	3.38 ± 1.49	<0.001‡
MD consultation time		0.63 ± 1.02	
Laboratory tests	11.31 ± 14.34	5.41 ± 9.45	<0.05
Medications	2.56 ± 2.08	2.89 ± 2.64	NS
Visit cost	20.08 ± 15.62	12.34 ± 10.79	<0.01

*Abbreviations as in Table 2.

†All P values determined by 2-tailed t-test.

‡Compares cost of physician time in MD group to combined cost of physician & NHP time in NHP group.

§Visit costs differ slightly from the sum of component costs because of rounding off of figures.

¶Not significant.

The average clinical *subgroup visit cost* for each of the four clinical subgroups is summarized in Table 3. NHP-group visit costs were significantly less for the upper-respiratory-infection and abdominal-pain subgroups.

Table 4 summarizes *average visit costs* for the MD and NHP groups on the basis of a weighted average (as described in Methods). Manpower costs were 46 per cent less in the NHP group ($P < 10^{-6}$). Laboratory and medication charges were not significantly different. Overall combined costs were 20 per cent less in the NHP group ($P = 0.01$).

Clinic staffing patterns provide indirect evidence of the effect of the NHP-protocol system, which has expanded in the two years since completion of the study. Before the study, 10 physicians and three NHP's saw

Table 4. Average Visit Costs.*

COMPONENT	COSTS (\$)		P VALUE
	MD GROUP	NHP GROUP	
Manpower	5.84	3.15	<10 ⁻⁶
Laboratory tests	8.43	7.35	NS
Medications	2.48	2.89	NS
Combined	16.75	13.39	0.01

*Weighted average calculated & tested for significance as in Methods & Table 1. Random & non-random groups were combined for each clinical subgroups before weighted averages were calculated. Thus, combined costs differ slightly from averages of the random & non-random visit costs of Table 1.

approximately 2700 patients per month, 70 per cent of whom had acute illnesses. Currently, 6.5 physicians and six NHP's see 2900 patients per month, 70 per cent of whom have acute illnesses.

DISCUSSION

New health practitioners — nurse practitioners and physician assistants — have been introduced with the intention of thereby improving access to care by minimizing the time and maximizing the output of the physician, while maintaining quality of care comparable to that provided by physicians. Numerous studies indicate that these goals can be achieved.^{1-10,14-19}

In studies that have considered the cost of an NHP system in different settings, the results have been influenced by the setting and study design. Some studies have indicated an increase in fee-for-service practice income^{20,21}; others have not.¹⁷ Several studies have indicated that an NHP system can lead to a reduction in overall costs of care^{7,8,13,15}; others have not.²²

A prepaid group practice (HMO) had direct incentives to employ NHP's. In fact, HMO's are increasingly adopting this approach, as described in several reports.²³⁻²⁵ In this study, we attempted to measure the impact on physician time and direct costs per patient encounter when NHP's became primary-care providers for adult patients with several common acute illnesses.

The study demonstrated that the NHP's could evaluate patients expeditiously while saving physician time. The time spent by the physicians (Table 2) in caring for patients with these problems when working with an NHP was reduced by 92 per cent, in comparison to the time they spent working without an NHP. Although a saving in physician time can be an important and even primary objective in the use of NHP's, physician time saving does not necessarily result in reduction of manpower costs. The NHP's could have spent an excessive amount of time with patients; however, the NHP's spent only four to nine minutes more than physicians per patient visit.

Indeed, the NHP system led to cost savings. Largely because of the considerable salary differential between the physician and the NHP, there was a 20 per cent reduction in combined average visit costs (Table 4) — including manpower costs, laboratory tests and medication charges.

If the patients in the NHP group had had complaints that were less complex and therefore required less time, diagnostic evaluation and treatment, the data could have been biased. However, there is no reason to believe that such a preselection occurred: patients were scheduled with MD's and NHP's by telephone operators without clinical training, according to whichever practitioners were available; the overall MD-group and NHP-group patients were not significantly different in terms of age, number of return visits

and subsequent hospitalization; and a randomly allocated subset was not significantly different from the total group in terms of age, return visits or hospitalizations, or average visit costs.

If the physicians who served in the NHP system as consultants to the practitioners had been more efficient than the physicians in the MD system, the provider time and cost data could have been biased in favor of the NHP system. However, our study controlled for this factor by using the same physicians in both the NHP and MD systems on a given day.

The physicians available for consultation in the NHP system were also seeing scheduled patients with chronic illnesses. We did not measure whether the time they spent in consultation affected their efficiency in caring for the scheduled patients. However, the physicians did not think that their efficiency had been affected.

Although we believe that our results accurately reflect a reduced cost per encounter in the NHP system, it cannot be assumed that this approach would necessarily lead to overall cost savings in other settings. In the first place, the results clearly depend on the skill and speed of the NHP's and physicians involved, their salaries, the charges for laboratory tests and for medications, and guidelines (if any) given the practitioners regarding the use of tests and medications. Secondly, the institution employing the NHP-physician team can only realize a saving if the decreased manpower cost per encounter is accompanied by a concomitant increase in the number of patients seen per unit time or if the number of physicians is reduced when patient volume remains constant. In our setting, patient volume has increased by 7 per cent, and physician number has decreased by 35 per cent.

Our results apply to the common acute illnesses studied, and not to other conditions seen in primary-care practice — other acute illnesses, chronic diseases or general screening examinations. In our study setting, the four acute-illness syndromes studied accounted for approximately 40 per cent of all patient visits, according to a preliminary survey.

We did not evaluate the quality of care in this study because we had done so previously. Patients with these four acute syndromes,^{1,3,5,8-10} as well as others,^{4,6} were seen either in an NHP-protocol system or an MD-system: symptom relief, diagnostic accuracy and patient satisfaction were shown to be equivalent or superior in the NHP-protocol system.

The protocols served as important tools in the initial on-site instruction of the NHP's. In addition, the continuing use of protocols after the introductory period was intended to encourage a relevant and efficient history and physical examination by the NHP. As mentioned earlier, this purpose was accomplished, and is in contrast to reports indicating that NHP's can spend an impractically long time per patient encounter.²² The cost of laboratory tests and

medications generated per visit were greater than manpower costs in this and other studies,^{7,8,13} and were borne largely by the HMO. Therefore, we intended that the protocols, by presenting clinically determined strategies for laboratory test and medication ordering, would encourage efficient utilization of these resources. In our study, the costs of laboratory tests and medications in the NHP-protocol system were equivalent to those in the MD system. The study was not designed to assess the degree to which protocol use may have accounted for this similarity. However, other studies of NHP's using protocols have shown equivalent or significantly reduced laboratory and medication costs.^{4,8,13} Indeed, studies have shown that physicians, as well as NHP's, order antibacterial medications²⁶ and laboratory tests²⁷ more appropriately when protocols are used. Furthermore, we and others have found that a data base accumulated through protocol use can be analyzed to identify additional strategies that further reduce costs while preserving the quality of care.^{28,29} Like the protocols, in which explicit strategies are referred to during patient care, the criteria-mapping technic, which applies similar branching logic strategies to retrospective peer review, may encourage more efficient use of resources.^{30,31}

In conclusion, in this ambulatory setting nurse practitioners and physician assistants using protocols in the care of patients with four common acute complaints led to a substantial reduction in physician time and overall costs. With further investigation, the replicability of this approach and the specific role of protocols in cost reduction should become clear.

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