Physician Assistants: Filling the Gap in Patient Care in Academic Hospitals

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The focus of this paper is to review the utilization of physician assistants (PAs) in the hospital setting, discussing a number of models that have been applied. PAs are suggested as one solution for meeting the manpower shortage in academic settings, caused by the implementation of Accreditation Council for Graduate Medical Education (ACGME) regulations limiting resident physicians' hours. PAs are also suggested as an option for improving resident physicians' educational experiences by performing tasks commonly performed by resident physicians that are low in educational value. Various studies are examined regarding the time utilization of internal medicine residents. Current data on the cost effectiveness of hiring PAs in the outpatient setting are reviewed; the data suggest substantial institutional savings. Although no comprehensive studies have evaluated the financial soundness of using PAs in the inpatient medicine setting, data are reviewed to estimate this consideration. Lastly, a review of physician assistant residency programs is discussed, and PA residencies are suggested as a potential approach for training and integrating PAs into the hospital setting.

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Introduction

Long work weeks and extensive hours of training for resident physicians have created the backbone of the nation's medical system. Many large hospitals throughout the country have depended on medical resident physicians to maintain adequate patient care. In 1989, New York became the first state to limit resident physicians' hours, to a maximum of 80 hours per week, which affected 15% of all resident physicians in the U.S.[1] With limitations on resident physicians' hours nationwide, there will be manpower shortages in the health care workforce, particularly in academic hospitals. Time utilization studies reveal that resident physicians spend the majority of their time in indirect patient care, an activity with low educational value.[2,3] The delegation of these activities to midlevel providers improves resident physicians' training and house staff efficiency.[2] Physician assistants are in a unique position, with their medical model of training, to help fill in the gap for inpatient medical care and improve the efficiency of resident physicians. This paper reviews the utilization and successful integration of PAs into physician residency programs and examines the role of PAs' work in the hospital setting. Lastly, we review the success of PA residency programs and consider the potential for new PA residency programs as a way to effectively transition PAs into the hospital setting.

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Graduate Medical Education Regulations

In 1989, New York became the first state to enact limitations on physicians' schedules in residency programs. These changes in the Hospital Code (405 regulations) limited the residents' workweek to 80 hours. The regulations stipulate that resident physicians (1) cannot be scheduled for more than 24 consecutive hours, (2) must have one 24-hour period off per week, and (3) must have on call periods separated by a minimum of 8 non-working hours.[3,4] Following the enactment of the 405 regulations, New York hospitals explored various approaches to accommodate the changes in resident physicians' availability. One approach involved hiring PAs to work with academic medicine teams and in residency programs in internal medicine, surgery, and orthopedics. Several models for integration of midlevel providers (MLP) have been studied and examined, as MLPs have become an integral part of hospital medicine in New York and throughout the country.

In June 2002, the Accreditation Council for Graduate Medical Education (ACGME) granted preliminary approval to the limitations on resident physicians' schedules in residency programs throughout the country, effective July 2003. The

new requirements are similar to the restrictions in New York. They include a maximum work week of 80 hours, continuous duty limited to 24 hours, one day in 7 free of patient care responsibilities, and in-house call scheduled no more frequently than every third night.[1] Failure to comply with these requirements threatens accreditation of residency programs.

As these dramatic changes are pending, maintaining patient care, particularly in large inner-city hospitals, is paramount. Regulation of resident physicians' hours will create a demand for health care providers in teaching hospitals across the country.[4] Earlier decreases in the number of resident physicians, the loss of accreditation of physician residency programs, and achieving better time utilization for resident physicians, are other changes that have contributed to introducing PAs into the hospital setting. The new limitations for physician residency programs can be expected to further increase their numbers.

Time Utilization of Resident Physicians

In an effort to maximize resident physicians' training experiences in the hospital setting, various studies have analyzed resident physicians' utilization of time. In these studies, activities are categorized according to the educational level, the relative directness to patient care, and the ability of physicians to delegate. Time usage studies of resident physicians in 3 Minnesota teaching hospitals revealed that 12% of residents' time was spent inserting catheters and drawing blood, procedures easily delegated to PAs.[5] The time utilization studies discussed below suggest that the delegation of resident and house staff responsibilities to PAs will allow for improved inpatient training experiences and more efficient physicians.[2,3,6]

Dresselhaus et al analyzed resident physicians' utilization of time by observing 60 resident physicians and sampling activities over 500 days. They found that activities involving direct patient care required 14% of resident physicians' time; 56% of time was spent on indirect patient care and 30% was spent on administrative activities. Of these activities, 45% were categorized as educational. Dresselhaus concludes that delegation of activities low in educational value, such as administrative activities and documentation, would maintain the value of the inpatient experience while reducing residents hours.[2] Dresselhaus further concludes that of the 40% of interns' time spent on documentation, testing, procedures, discharge summaries, consultations, and miscellaneous administrative tasks, half of it could be delegated to nonphysicians. These results correspond with time utilization studies done by Knickman et al, which found that 20% of house staff activities could be done by nonphysicians.[3]

Knickman et al studied how residents spend their time in hospitals, categorizing tasks as educational, tasks that can only be done by a physician, and tasks that can be completed by a nonphysician provider. Data were collected in 1988 from 8 resident physicians in 2 New York hospitals. Resident physicians recorded over 1,700 specific activities. Findings revealed that most educational activities occurred during the day: 31.9% of day activities involved educational activity, while only 1.1% of night activities were educational (see Table 1). Knickman concluded that reducing the amount of time residents spend on in-house call will have little impact on the percentage of time spent on educational activities.[3]

Furthermore, less than half of the residents' time (46.7%) was spent on activities that required a physician. And 74% of the total time spent on physician activities involved information gathering, consultations, and documentation. It is possible that these activities could also be delegated to midlevel practioners.[3]

Limitations of the study included a small sample size and a coding system that did not account for simultaneous activities. When simultaneous activities occurred, the activity which was most "physician requiring" was recorded, thus physician-requiring activities may have been overestimated.

Similar results have been reported in a study of 35 house officers in Minneapolis in 1989.[5] Lurie et al studied on-call time utilization of internal medicine resident physicians in 3 teaching hospitals. Observers trained in documenting activities followed 35 resident physicians. Lurie et al concluded that house officers spend more time documenting than they do providing direct patient care. In addition, 12% of residents' call time involved procedures which nonphysician providers are qualified to perform, leading Lurie et al to further conclude that "it is ultimately inefficient and may be inappropriate for physicians in training to do work that could be done by nonphysicians."[5]

Table 1

Distribution of Resident Physicians' Time Spent in Activities That Must Be Carried Out by a Physician, According to Two Models of Health Care*

	Traditional Model		MLP Model	
Type of Activity	Minutes	% of Time	Minutes	% of Time
Information gathering	1,791	28.7	239	8.9
Testing	596	9.5	595	22.1
Interaction with patients	30	0.5	30	1.1
Consulting	1,545	24.7	828	30.7
Documenting	1,313	21.0	143	5.3
Procedures	225	3.6	111	4.1
In Transit	747	12.0	747	27.7
Total	6,248	100.0	2,693	100.0

Data from Knickman et al[3]

The above data support MLP substitution for activities of lower educational value including documentation, routine procedures, discharge summaries, and consultations. These activities coincide with the basic job description of a house staff PA as described in Figure 1.[6-8] In addition, allowing MLPs to share overnight call responsibilities provides better optimization of training time for resident physicians as well as compliance with Graduate Medical Education regulations.

Figure 1

Job Description of a House Staff PA

As a member of the health care team, the PA will provide medical and/or surgical support to the hospital's attending physicians, nurses, and patients and may perform the following functions:

- Screen patients to determine need for medical attention.
- Take patient histories, perform physical examinations, and identify normal and abnormal findings on histories, physicals, and commonly performed laboratory studies. Record pertinent patient data in the medical record.
- Carry out or relay a physician's orders for diagnostic procedures, treatments, and medication in accordance with existing drug laws. The PA may transcribe the orders on the patient chart as a verbal or telephone order from the physician and may then sign it. The physician may review orders written by PAs.
- Collect specimens for commonly performed laboratory procedures; collect urine, sputum, stool specimens, and cultures for laboratory analysis.
- Evaluate patients in the emergency department for traumatic and surgical problems.
- Conduct daily patient rounds. Evaluate changes in patients' condition. Issue orders for medications, treatments, and laboratory tests.
- Write discharge summaries.
- Perform the following clinical procedures, subject to institutional credentialing:
  - Venipuncture/arteriopuncture, electrocardiogram recording
  - Administer intravenous medications and contrast materials for radiologic studies
  - Collect fluids, blood, and blood components upon order from a supervising MD
  - Administer injections: intramuscular, intravenous, or intradermal
  - Perform nasogastric intubation, endotracheal intubation, insertion of urinary catheters
  - Clean and debride wounds
  - Administer local infiltrative anesthesia
  - Suture laceration: injuries involving arteries, tendons, or nerves, examined by the supervising physician prior to the institution of therapy
  - Apply dressings, bandages, and splints. Apply and remove casts.
  - Cardiopulmonary resuscitation
  - Assist in surgery, fulfilling all requirements of a surgical assistant
  - Provide pre- and postoperative surgical/medical care
  - Provide patient education and health-promotion and disease-prevention instructions
  - Be available for "call" as determined by the department
- Other duties as delegated by the physician and approved by the credentials committee of the institution

(Data from Schafft,[6] AAPA Web site,[7] Cawley[8])

Integration of Physician Assistants into Medical Residency Programs

Many full-time PAs have been integrated into surgical and orthopedic residency programs in response to a decrease in the total number of resident physicians, and in an effort to increase resident physicians' time spent on educational activities. Perry and colleagues distributed a questionnaire in 1981 to 552 department of surgery chairs and found that one-third of hospitals employed at least one PA.[9] Surgical and orthopedic residency programs have reported success in hiring full-time PAs to work within and alongside their residency programs.[9-12] Models used showed varying degrees of integration as well as replacement of resident physicians in a Michigan critical care unit.[12] In Connecticut, a surgical residency program used a partial integration approach, with a separate PA service and a separate physician service, combined educational activities, and resident physician responsibility for teaching PAs. In New York, an orthopedic residency program also created separate PA and resident physician teams, each splitting overnight emergency room call and inpatient responsibility. Patients were transferred from the resident physicians' service to the PA service following initial recovery or diagnosis. In Pennsylvania, in 1983, PAs were hired following the loss of accreditation of a hospital's surgical residency program, and were completely integrated into the surgical residency program 12 years later when it was reinstituted.

Following a scheduled downsizing of residency programs in 1979 at New Britain General Hospital in Connecticut, Russell and colleagues detailed their 20-year experience following the institution of surgical PAs.[11] Goals of introducing PAs included meeting expectations for in-house coverage of surgical patients, complying with the guidelines of the Residency Review Committee (RRC) and ACGME, and protecting resident physicians' time for conferences and clinics. Their model is a partially integrated approach with a PA service and a physician service with independent admitting days and one service on call per night. The PA service is overseen by the chief resident physician and is stratified in a similar manner to the residents' service. Junior PAs and senior PAs had similar responsibilities to junior and senior residents. This program succeeded in meeting set goals, reported good acceptance of the PAs, and revealed equal satisfaction in the physician-PA model from the residents and the PAs.

Russell reported that "despite having to share the surgical case load with PAs, nearly all resident physicians have been satisfied with their operating room experiences. They realize that the PAs facilitate their overall clinical and educational experiences, rather than detract from them."[11] Good job satisfaction was also reported by the PAs. Russell and colleagues report that the ratio of the number of PAs required to replace resident physicians is close to 1:1. The cost of PAs in this study included salaries and benefits, but also the loss of reimbursement, both Medicare and indirect. The direct cost of PA replacement was estimated at $150,000 per resident physician per year; however, no details were given regarding this estimate. PA-generated revenue was not used in this estimate, but was identified as a source for recovering some of this cost.[11]

Following a planned decrease in the size of a New York general surgery training program in 1979, the department of orthopedic surgery in a Rochester hospital employed 6 PAs for integration into the orthopedic residency program. Goals included maintaining educational needs of orthopedic resident physicians while meeting the responsibilities of the emergency department and the inpatient population. The 6 PAs were evaluated from 1979 through 1986. Resident physicians and PAs split call responsibilities and resident physicians transferred patient responsibility to the PA team once patients were well into convalescence. The PA service consulted resident physicians with any problems and resident physicians played a significant role in teaching the PAs. PAs shared coverage of the emergency department and reported to resident physicians or the attending physician after evaluating patients. Although the orthopedic residency program had difficulty finding objective measurements to evaluate the effectiveness of the program, they reported positive subjective measures including favorable reports from resident physicians, attending physicians, and support staff. No malpractice litigation occurred during the 7 years, and the hospital was able to increase the volume of work while keeping the same number of attending physicians and resident physicians. According to Dr. McCollister Evarts, "The perception of those on the orthopedic staff at the senior author's hospital is that the integration of PAs into the orthopedic service has been a great benefit and has helped achieve the two goals of resident physician teaching and maintenance of services. Patient acceptance has been extremely high, especially among the group of people seen in the emergency room. Since one PA is present whose primary responsibility is only to the orthopedic care in the emergency room, evaluation can usually be quite prompt and care rendered without significant delays."[13] The residency program reported regular chart review, prompt countersigning of orders, review of x-ray diagnoses by a radiologist, and good communication between PAs and physicians to be very helpful in ensuring effective PA integration.[13]

In 1983, at St. Luke's Hospital in Pennsylvania, PAs were hired in the general surgery service following the loss of accreditation of St. Luke's general surgery residency program. Following reinstitution of the general surgery residency in 1995, surgical PAs were successfully integrated into the surgical residency program working in general surgery and in subspecialty services.[9] At St. Luke's Hospital, PAs functioned at the level of postgraduate year 1 (PGY-1) or postgraduate year 2 (PGY-2) resident physicians. One PA was assigned to each of the general surgery services including general, colorectal, and vascular surgery. PAs also covered subspecialty services on a monthly basis when there were no resident physicians available to cover. Rosenfeld reports that PAs were better able to provide continuity of care for patients as compared to rotating resident physicians. The surgical PAs took call coverage, taught procedures to medical students, and first assisted in the operating room under direct supervision of senior surgical residents. PAs reported to senior surgical resident physicians and to attending surgeons regarding patient care. Utilization of surgical PAs at St. Luke's Hospital prevented the need for cross-covering resident physicians from family practice and internal medicine residencies which increased resident physicians' time for educational activities and conferences.[9]

In an 8-bed critical care unit (CCU) in Michigan, PAs replaced resident physicians for a 2-year period. Dubaybo et al[12] observed the CCU for 4 years, 2 years with resident physicians only, and 2 years with PAs. They monitored the number of monthly admissions, occupancy rate, APACHE II score as an index of intensity of disease, duration of stay, mortality, number of invasive procedures, number of complications, utilization of lab resources, and quality of care. Two resident physicians covered the 8-bed CCU from 1984 to 1986. From 1986 to 1988, 4 PAs replaced the resident physicians, 2 per day shift, with night coverage by on-call physicians. PAs maintained responsibility for charting and for admission work-ups throughout the night. The PAs had several years experience prior to being hired, and spent 3 months rotating and training with fellows and intensivists once hired. Following the 3-month period, PAs' assigned duties were identical to resident physician duties, except that physicians visually observed all invasive procedures performed by PAs. After the introduction of PAs to the CCU there was a slight reduction of patients admitted and a slight increase in duration of stay.[14] The occupancy rate, mortality rate, number of complications, and the adequacy of charting remained unchanged. Although utilization of lab studies was increased, the total number of studies requested remained within acceptable averages for patients in an intensive care setting.[12] Dubaybo et al concluded that care of critically ill patients was not compromised, and that PA substitution was well accepted in the medical and nursing establishment. Dubaybo recommended hiring only highly qualified individuals with previous hospital experience along with

formal training of PAs upon hire. No discussion was offered regarding financial compensation.

Each of the preceding examples detailed the effective integration of PAs into specialty residency programs in hospital settings, from partial integration involving separate physician and PA teams to replacement of resident physicians in the critical care setting. A benefit of permanent PA employees working with resident physician teams includes continuity of care each month following the rotation of resident physicians. As the only permanent members of the team, PAs are also able to help the transition of resident physicians onto the service each month. Data reveal that PAs trained to function in medicine specialties are able to provide care with similar competence and skill to first-year resident physicians in the same position.[6,8] Appropriately trained PAs are able to meet most requirements of a house staff employee, whether employed exclusively or in conjunction with physician residents.[10] Although objective data is limited, most subjective data reveal success in PA integration as well as positive reactions to PAs by the health care team.[6,15]

Physician Assistant Models for Inpatient Medicine

According to the 2001 American Academy of Physician Assistants PA Census report, 40% of the clinical practicing PAs responding to the survey reported working in the hospital setting.[7] Of these PAs in the hospital setting, 20% work on inpatient units, 6% work in critical care units, and 21% work primarily in the operating room. Another 27% work in emergency departments and 22% are in the outpatient units.[7]

Not only are PAs working in the inpatient setting, many hold privileges previously delegated to physicians only. Forty-five percent of PAs in a national study of 1,690 hospital PAs reported house officer status while 90% of respondents held formal medical staff privileges and were credentialed under hospital bylaws.[6] McKelvey reports high levels of acceptance from patients and physicians following the addition of PAs to the inpatient medical staff. As detailed later in the paper, a favorable cost benefit analysis along with reports of high quality of care supports the integration of PAs.[11] PAs may also seek additional training in specialties and specialty oriented technical procedures. In a 1987 study, PAs performing coronary angiograms were found to have a lower complication rate than cardiac fellows.[6,16] Today, inpatient PA house staff are responsible for a wide range of duties, including bone marrow aspiration, thoracentesis, lumbar puncture, coronary angiography, and invasive radiologic procedures, as well as various technical procedures.[6] Extensive data has shown the clinical efficacy of PAs in the inpatient setting.[6] Hospitals report the use of PAs in a variety of areas including medical intensive care, burn units, emergency medicine, cardiology, gastroenterology, general surgery, cardiothoracic surgery, neurosurgery, neurology, orthopedics, cardiac and renal transplant teams, urology, radiology, and in the care of hospitalized children.[4,6,12,17-19] According to James Cawley, "Hospitals have found that by adjusting the mix of attending physicians, resident physicians, and PAs, it is possible to reduce overall salary costs for inpatient staffing yet preserve adequate levels of medical care."[8]

The studies discussed below report the success of "substituting" PAs for resident physicians, but the term "substitution" is misleading in the context of replacing residents with PAs. PAs practicing in inpatient medicine function as part of the health care team, directly under the supervision of physicians. PAs are not and do not hope to be independent practitioners. PAs function to enhance and extend the practice of physicians, not replace it. With that in mind, the following studies use substitution of physicians as a method of analyzing effectiveness of PAs in the academic inpatient setting.

In 1995, Riportella-Muller et al investigated the prevalence of substituting MLPs for resident physicians, through survey distribution to medical directors in the Council of Teaching Hospitals. One hundred seventy-eight hospitals (62%) reported substituting MLPs for resident physicians occurring in 463 clinical departments. A second survey was distributed to the 463 departments revealing 116 programs utilizing PAs to perform tasks previously done by resident physicians, 77 programs using NPs, and 62 using both PAs and NPs. Of the PA substitutes, 42% of substitutes were surgical, 25% primary care, and 21% were involved in medical subspecialties. Several survey participants commented that the hospital's inability to offer competitive salaries hindered hiring PA and NP providers. Another limitation identified was the scope of practice for individual states, as some states have limited reimbursement for MLPs. Riportella-Muller reported that approximately two-thirds of departments surveyed planned to maintain their current level of substitution, while one-third planned to increase or extend the number of PA/NP substitutions.

A follow-up phone survey of 20 respondents explored the need to utilize MLPs. The reasons respondents gave included changes in the number of residency slots and improved quality of care afforded by permanent workers. Riportella-Muller summarized, "almost every respondent reported satisfaction with their experience with substitution by MLPs and many expressed enthusiastic support from all quarters, including attendings, resident physicians, nurses and patients."[14] Several respondents mentioned some initial resistance to utilizing nonphysician providers in this manner, but reported that the resistance subsided with familiarity and experience.

The following 2 examples evaluate the use of PAs in academic hospitals through 2 distinct approaches. The first model incorporates PAs into the resident physicians' inpatient teams. Following his studies on time utilization for residents, Knickman suggested midlevel practitioner substitution for resident

physicians, citing the benefits of a close relationship between the physicians and midlevel providers.[3] Through this relationship a medical plan is developed and implemented for each patient, reducing the amount of time each resident spends per patient. Knickman's model for MLPs assigned a MLP as the primary patient manager who was responsible for baseline patient care monitoring, including information gathering and documentation, both time-consuming activities for resident physicians. The physicians made key medical decisions and followed medical progress, while the MLPs were responsible for monitoring and coordinating care as well as implementing medical decisions suggested by the physician. In comparing Knickman's midlevel provider model with the traditional model, without MLPs, 35% of resident physicians' time can be substituted by midlevel practitioner time with 45% of resident physician's workload to be assumed by other employees, including nurses, clerks and MLPs (Table 2). Time required by resident physicians for information gathering decreases from 28% of physician time in the traditional model to 8.9% in the midlevel provider model. Residents' time spent documenting activities also decreases from 21% to 5.3% with the midlevel provider model as shown in Table 3. Knickman concluded that there is a substantial potential for MLPs to work in the inpatient setting and that only 20% of resident physicians' lost hours need to be covered by a physician.[3]

Table 2

Distribution of Resident Physicians' Time According to Type of Personnel Who Potentially Could Be Substituted to Carry Out Their Activities, According to Two Models of Health Care* (Extrapolated MLP activities)

		Personnel Who Could Be Substituted	
Activity	% of time	Traditional Model	MLP Model
Information gathering			
History	3.4	Physician	ML Prov.
Physical	2.3	Physician	ML Prov.
Chart review (not lab tests)	5.9	Physician	ML Prov.
Testing			
Perform (venous)	3.1	ML Prov.	ML Prov.
Perform (arterial)	1.0	ML Prov.	ML Prov.
X-Rays			
Order and arrange	0.14	ML Prov.	ML Prov.
EKG			
Interpret results	0.33	ML Prov.	ML Prov.
Urinalysis			
Interpret results	0.03	ML Prov.	ML Prov.
Consulting			
Nursing	0.46	ML Prov.	ML Prov.
Other hospital staff	1.7	Physician	ML Prov.
Sign-out rounds	1.9	Physician	ML Prov.
Other resident physicians	6.2	Physician	ML Prov.
Documenting			
Chart notes	6.9	Physician	ML Prov.
Written orders	2.1	Physician	ML Prov.
Discharge summaries	0.40	Physician	ML Prov.
Personal notes	0.12	Physician	ML Prov.
Procedures			
Cardiac arrest	0.85	Physician	ML Prov.
Giving intravenous medications	1.0	Nurse	ML Prov.
Interacting with patients			
Instruction or counseling patient	1.7	MLP Prov.	ML Prov.
Instruction or counseling family	0.7	MLP Prov.	ML Prov.
Total	40.23		

Table from Knickman et al.3

Knickman identifies and proposes the following activities for MLP substitution: completion of history and physical, review of charts, blood tests, ordering X-rays, interpretation of EKGs and UAs, documentation of chart notes, writing orders, completion of discharge summaries, and instruction in counseling of patient and family. These areas of substitution coincide with the basic job description of a house staff PA[6] (Table 3). Knickman states "if current approaches to patient management are continued, approximately half of resident physicians' time must be replaced with other physicians. However, if patient management can be restructured so that midlevel practitioners take on enhanced responsibilities for managing, implementing, and documenting medical plans for patients, then just 20% of each resident physician's lost time needs to be replaced with other physician's time."[3]

Abrass et al evaluated a different approach for supplementing inpatient medicine residents with a triaged short-stay unit managed by a PA team.[17] In response to physician workloads exceeding the work capacity of existing faculty at a county-owned hospital in Washington, a short-stay service staffed by PAs was implemented. Community acquired pneumonia (CAP), uncomplicated deep vein thromboses (DVTs) and cellulitis were identified as appropriate diagnoses for a short-stay unit (SSU). Inclusion criteria included well-defined clinical pathways for each diagnosis and the percentage of admissions for the 3 diagnoses met the goal of 25% of admissions for the

Table 3

Distribution of General Internal Medicine Bed in the Detroit Medical Center

	A Service[a]	B Service[b]	Total[c]
Harper Hospital	100	232	332
Hutzel Hospital	50	84	134
Grace Hospital	50	80	130
Detroit Receiving Hospital	100	0	100
VA Medical Center	100	0	100
Total	400	396	796

[a]A Service = teaching beds, resident physician
[b]B Service = nonteaching beds, PA
[c]Excludes specialty wards and intensive care units
Data and table from Frick[19]

SSU. The clinical pathway for CAP was extensively studied prior to initiating the SSU. Factors examined included disease severity, mortality, and cost. The data revealed a reduced length of stay, decreased hospital costs, and maintained quality of outcomes with clinical pathway utilization. As a result, the SSU was implemented. The SSU employed 2 PAs and 2 advanced registered nurse practitioners (ARNPs), each working four 10-hour shifts per week, alternating weekends. Attendings, fellows, and resident physicians supervised PAs. The goals of the SSU model were to reduce the workload of resident physicians and faculty physicians and to allow for a greater focus on residents' educational activities. Although financial implications of the SSU model are still pending, the initial implementation of the clinical pathway for CAP treatment, prior to PA involvement, revealed an average reduction of length of stay by one day with a subsequent reduction in hospital costs of approximately $1,000 per patient. This clinical pathway for CAP provided support for initiating clinical pathways for DVTs and cellulitis and hence the short-stay unit.[17] Preliminary analysis reveals revenue from the SSU will cover staffing costs, and it is expected that hospital costs will be reduced. A survey of physicians found biases toward the ability of PAs to perform tasks previously performed by resident physicians. Abrass concluded that extensive education is necessary prior to implementation of PAs to ensure an effective integration.[17]

Benefits of replacing resident physicians with MLPs include improved continuity of care and coordination of care, which will likely contribute to better outcomes, shorter length of stay, and financial savings.[6] PA house officers do not require retraining every year and have the unique opportunity to contribute to the efficiency of the team by improving intern transition into the hospitals through training in clinical procedures, hospital protocol, routines, and resources.[6] "Even within one to two years of working on a subspecialty service, a PA may have more practical and relevant clinical experience than a resident physician would have within the given subspecialty."[18]

Cost Effectiveness of Physician Assistants

Evaluating PA cost effectiveness is a complex task. It is difficult to quantify a medical encounter given varying severities of illnesses, types of treatment, different utilization of tests, level of provider training, as well as different systems for reimbursement and payment and different styles of task delegation.[6] When evaluating PAs there are additional complications. PA and physician services commonly overlap and in the inpatient setting PAs are part of a team caring for a group of patients. In addition, PAs depend on physicians and function as an extension of the physician. It is also difficult to compare PA and physician services when PAs are intended to complement physicians' services. Cost effectiveness is dependent upon the degree of delegation and effective utilization of the PAs' skills by the physician. Finally, it is difficult to analyze the non-monetary benefits of PAs in the inpatient setting, such as continuity of care, contribution of PAs to the educational experience of resident physicians and medical students, improved time utilization for residents, and possibly an increase in the amount of time spent on direct patient care and education.[6]

The data on cost analysis for PAs is limited and is primarily in the outpatient setting. Although this data cannot be directly generalized to the inpatient setting, it supports the cost effectiveness of PAs when utilized well by a physician in the outpatient setting.[21] Major studies analyzing outpatient PA productivity and cost-effectiveness reveal that PAs typically generate revenue far beyond their salaries and overhead, providing lower cost health care than that provided by physicians.[6,21] In a 1973 study of 9 outpatient medical practices with PAs, physician-PA team practices improved clinical productivity by 40.4% compared to an increase of 1.3% in a control group during the same period of time. Clinical productivity was measured as the number of clinic visits.[6] The final report from the Physician Extender Reimbursement study stated, "Practices with physician extenders (PAs or NPs) provide more patient visits per $1,000 of practice cost at a higher quality of care and with less charge to the patient or third-party payer than do traditional practices. The use of physician assistants in the ambulatory care setting appears to be beneficial in terms of costs, providers, and patients."[6]

In a primary care study of 3 departments, Hooker found the total cost of an episode managed by a PA to be less than when managed by a physician.[21] This study, through the Northwest Division of Kaiser Permanente, included 305 providers with over 12,000 office visits for urinary tract infections, shoulder

tendonitis, acute bronchitis, and otitis media. Costs included in the study were medication, imaging, laboratory, and the medical office visit (provider salary plus overhead for each visit). Hooker found an office visit with a PA at this institution was 25% less than the cost of a visit with a physician. The mean salary in this HMO at the time of the study for a primary care PA was $54,000, compared to $124,600 for a primary care physician. "Employment of PAs appears to be a labor-saving strategy which does not generate additional visits, result in additional referrals, or consume more resources than when the physician is the provider of record."[21] Patients in the study were all under 65 and had only one diagnosis for an episode of care. Further studies more representative of all patients seen by PAs would be helpful.

In a Southern California Kaiser Permanente Facility, prior to the implementation of a physician assistant protocol system, 10 physicians and 3 physician extenders saw 2,700 patients per month. After the implementation of PAs 2 years later, 6.5 full time equivalent (FTE) physicians and 6 physician extenders saw 2,900 patients per month. The authors concluded that the addition of PAs resulted in a 20% reduction in average visit costs.[6] Sox reviewed 21 studies directly comparing care given by PAs and NPs with that of physicians. He concluded that the care PAs and NPs provide in a primary ambulatory was indistinguishable from physician care.[22]

Unfortunately, cost analysis data on PAs commonly involves PA substitution for physicians. These studies fail to evaluate PAs as part of the multidisciplinary team where physician and PA medical care frequently overlaps. Hooker and Cawley have reviewed the cost effectiveness data of PA substitution for physicians in primary care, and concluded that the most rigorous study reveals a substitution ratio in primary care medical offices of 0.83; one PA substitutes for about eight-tenths of a physician. Various studies report productivity of PAs in primary care ranging from 75% to 100% of physicians' productivity.[15] Reviewing this data, Hooker and Cawley state "If we accept the fact that PAs are at least three-fourths as productive as physicians and capable of managing at least 83% of all patient care encounters, and if we recognize that the mean salary of a PA is half that of a licensed primary care physician, we can begin to appreciate the considerable cost-effectiveness of PAs in clinical practice."[6]

PA substitution for resident physicians in internal medicine contributes to the continuity of care, improves the educational experience of residents, and decreases costs on an annual basis.[6,19] In 1990, Thorpe surveyed all New York state hospitals to evaluate the financial implications of capping residents' work schedules.[23] Thorpe estimated that reducing resident physicians' schedules to 80 hours per week would require 424 full time equivalent (FTE) personnel to maintain existing patient care in New York hospitals. Internal medicine was noted as needing the largest amount of substitution, 231 FTEs. Physician replacement for all specialties was estimated to cost $159.6 million, PA replacement was $56.9 million, and a mix of physicians and PAs was estimated at $85.1 million. Physician replacement for internal medicine was estimated at $23 million, PA replacement at $9.2 million, and a mixed replacement at $13.8 million. By allowing PAs to contribute to filling the gap in care, New York state hospitals estimated savings of $74.5 million and internal medicine would potentially save $9.5 million.[23] Hospitals have found that by adjusting the mix of attending physicians, resident physicians, and PAs, it is possible to reduce overall salary cost for inpatient staffing, while preserving adequate levels of medical care.[6]

The remarkable integration of PAs into a 5-hospital system in Michigan has not only been effective but has revealed financial benefits as well as a decreased need in the number of internal medicine resident physicians.[6,19] Following the merging of 5 hospitals, with over 1000 medical patients, the department chairs of the internal medicine residency program chose to restructure the program based on the successful integration of PAs in the oncology division. PAs were utilized to fill service needs, allowing for an improved educational experience for internal medicine residents.[19] Table 3 shows the distribution of internal medicine beds in the Detroit Medical Center. Prior to PA integration, 20 interns, 10 PGY-2s, and 10 PGY-3s managed 332 medical beds, with an average caseload of 16.6 patients. Following the new staffing pattern, with 10 daytime PAs and 2 evening PAs, 232 beds were managed by PAs, leaving 100 beds to be staffed by 8 interns and 4 PGY-3s, with an average of 12.5 patients per intern. The PGY-2s were then able to rotate in medical subspecialties.

Table 4 shows how the adoption of a new model of care at Harper Hospital resulted in an overall savings to the program and institution of over $300,000.[6,19] The data for the number of PGY-1s and the PGY-1's salary does not equal the expenditure for PGY-1s; however, it is not significant in the overall cost savings reported.

Frick describes the following benefits for the department of internal medicine residency program following PA integration:

- Educational needs placed ahead of service needs
- Class size based on educational needs
- Controlled caseload size and controlled caseload composition
- Improved house staff
- Conversion of PGY-2 year into subspecialty year
- Increased faculty:resident physician ratio
- A savings of $300,000[19]

Postgraduate Physician Assistant Residency Programs

In 1971, the first postgraduate PA program was instituted in New York, to train PAs to replace surgical house offi-

Table 4

Costs of Coverage of General Medical Service, Harper Hospital

Position	Old Number Required	Cost per Service Year	Expenditure
Resident physician coverage			
PG-I	20	26,640	532,800
PG-II	10	30,540	305,400
PG-III	10	47,200	472,000
Total			$1,310,200
Resident physician/PA coverage		(Transitional Cost Per Service Year)	
PG-I	8	29,860	236,800
PG-II	4	30,540	122,160
PG-III	4	47,200	188,800
Subtotal, resident physician coverage			$547,760
Physician assistants	11	33,540	368,940
House physician back-up*			82,368
Total			$999,068
Total costs of medical service			
Resident physician coverage			1,310,200
Resident physician/PA coverage			999,068
Cost savings to service			$311,132

*Moonlighting house physicians provided evening and weekend backup

Data from Schafft et al[6]

cers. In 1975, Yale University created a one-year surgical residency program for PAs with combined didactic and clinical teaching, which is the current model for many postgraduate PA residency programs. Postgraduate PA residencies reached a peak in the early 1990s at 20 programs throughout the country. In 1999, PA residency programs were available in dermatology, emergency medicine, ob/gyn, occupational medicine, orthopedics, pediatrics, primary care/internal medicine, rural primary care, and surgery.[24] Hospitals have initiated PA residencies to fill the gap in patient care in response to downsizing of resident physician programs, and to allow resident physicians to better utilize their time, increasing time spent on educational activities.[4]

In New York, following reductions in resident hours, the North Central Bronx Hospital and the Montefiore Medical Center (MMC) developed a postgraduate internship in obstetrics and gynecology for PAs.[4] Initiated in 1986, the program was modeled after successful surgical PA residency programs. The ob/gyn residency is 15 months long, starting with a 3-month didactic program, followed by complete integration of PAs into the physician residency program. PAs take call every third night and attend daily teaching rounds and weekly grand rounds. Several of the PA residency graduates are now staff PAs at MMC, where they have primary responsibility for PA students and PA interns. Staff PAs are also responsible for planning the clinical curriculum, giving lectures, and teaching PA students. McGill et al reported great acceptance and success in this program.[4] Staff PAs orient the physician interns, and as permanent members of the house staff team, they are able to serve as a valuable resource. McGill also states that graduate medical education appears to have improved in general as a result of PA interns and staff PAs with postgraduate training in ob/gyn.[4] Four years after the development of the postgraduate internship, 150 PAs were employed at MMC in surgery, internal medicine, medicine subspecialties, emergency medicine, ob/gyn, employee health services, transplant services, and burn units, as well as in various administrative and research roles.[6]

As of June 2003, no internal medicine or hospital medicine residencies for PAs exist. With further evaluation, these types of PA residency programs could educate and transition PAs into the inpatient setting. In general, PA residency programs are estimated to be less expensive than hiring full-time PAs and would help to ensure proper education, as well as adequate familiarity with individual PA performance prior to hire. The inpatient PA residency program offers a unique opportunity to explore how PAs can best integrate into hospital medicine and help fill the gap resulting from reductions in resident physicians' hours.

Conclusions

With changes in resident physicians' available hours and the availability of studies documenting the poor time utilization of residents and the successful delegation of their responsibilities to MLPs, the value of PAs to the academic hospital setting is apparent.[2,3,5] There are numerous models for incorporating PAs into the hospital setting: integration of PAs into residency programs, separate PA and resident teams with similar patients, separate PA teams managing triaged patients in a SSU, as well as the substitution of PA services for residents' services. Benefits of PA integration in the hospital setting include improved continuity of care, improved educational experiences for residents, and the presence of a permanent member of the team to help transition resident physicians onto the service. Subjective data reveals success in each of these models as well as financial benefits in the MMC experience.[19] PA residency programs are estimated to be less expensive than hiring full-time PAs and would ensure proper education, as well as adequate familiarity with individual PA performance prior to hire. Future inpatient PA residency programs could be a cost-effective approach to transitioning PAs

into the hospital setting. PAs, with a medical model of training, are able to integrate into this setting and help fill a need as well as create a more efficient approach to inpatient medicine. More objective data is needed to determine the most effective approach to PA integration, and each hospital needs to customize PA integration to best fit its needs.

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