PAPER

Midlevel Practitioner Workforce Analysis at a University-Affiliated Teaching Hospital

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Objective: To quantify midlevel practitioner (MLP) staffing requirements based on the volume and complexity of patient care and the duty-hour constraints of the Accreditation Council for Graduate Medical Education 80-hour workweek.

Design: Data extracted from Eclipsys Sunrise Decision Support Manager, the hospital financial budget, and census reports; and MLP, resident, and subspecialty fellow clinical, operative, and on-call schedules, and educational curriculum. Fiscal year 2005 patient census and hours of required care were defined by attending physician service and/or patient care location. Volume of patient care activity for MLPs, residents, and subspecialty fellows were established by verified self-reporting methodology.

Setting: Urban teaching hospital with 867 beds, of which 116 are surgical beds (which include 36 intensive care unit beds and 12 step-down beds).

Participants: Attending physicians, MLPs, residents, and subspecialty fellows.

Main Outcome Measures: Coverage index (available staffing hours [residents, subspecialty fellows, and MLPs] divided by the clinical coverage schedule), and the workload staffing efficiency index (number of clinical hours of patient care activities divided by the hours of available staff for a specific clinical service).

Results: The workload staffing efficiency index and the coverage index identified 4 services that benefited from the addition of new MLPs.

Conclusion: We developed a quantitative MLP staffing methodology based on patient volume and the type and complexity of direct and indirect patient care activities, encompassing the roles and availability of residents, subspecialty fellows, and MLPs.

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On July 1, 2003, the Accreditation Council for Graduate Medical Education (ACGME) required all accredited residency training programs to comply with an 80-hour workweek, limiting available residents' daytime and on-call duty hours to education-based activities. These include direct patient care activities, such as admissions, discharges, consultations, bedside care, and participation in the operating room, as well as participation in didactic core curriculum conferences and rotation-based lectures.[1-3] The resultant shortfall of resident and subspecialty fellow duty hours to provide patient care services has driven hospitals to hire an increasing number of midlevel practitioners (MLPs), also known as physician extenders (physician assistants and advanced-practice registered nurses), to provide direct and indirect patient care and ensure patient safety and care quality.[2,4-6]

Our department of surgery conducted an MLP resource analysis based on the volume, type, and complexity of patient care within various clinical services, incorporating the reduced availability of residents under the ACGME 80-hour workweek. The workload staffing efficiency index and clinical coverage needs for 24-hours-a-day, 7-days-a-week operation were calculated. The analysis identified 4 services that benefited from the addition of MLPs based on patient care activity.

METHODS

The analysis was conducted from October 2004 through September 2005, using the hospital, clinical, and administrative databases, and the hospital financial budget and census reports. Service-specific patient care volumes and scheduled hours of care were defined by physician service and/or patient care location. The patient population of the intensive care unit (ICU) was defined as patients with a length of stay in a respective ICU, while the transplant pa-

Table 1. Physician-Level Patient Care Activities

Activity	Vascular Surgery	General Surgery	Cardiac Surgery	Transplant Surgery	Plastic Surgery	General Surgery ICU	Cardiovascular ICU	Neurointensive ICU
MLP Admissions, h/Patient								
Emergency department admissions	Stable, 1 Emergent, 2	1.5	1.5	1	1	Stable, 1 Emergent, 3	Stable, 1 Emergent, 3	Stable, 1 Emergent, 3
Floor consult	40% Stable, 1 60% Critical, 2	1	1	.75	0	3	3	3
Transfer in*	40% Stable, 1 60% Critical, 2	0	0	0	0	3	3	3
Postoperative care	2	0	0	0	1	1	1	1
Transplant consult	0	0	0	2	0	0	0	0
MLP Discharges, h/Patient								
Routine patient care†	.5	.5	.5	.25	.33	0	0	0
With home care	1.5	.75	.75	.75	1	0	0	0
To an SNF	1	1.5	1.5	.75	1	2	2	2
Transfer out of unit‡	0	0	0	0	0	2	2	2
Other MLP Clinical Activities, h/wk								
Morning patient care rounds	7.5	7.5	0	0	7.5	10.5	10.5	10.5
Evening patient care rounds	7.5	.33/patient	0	2	0	10.5	10.5	10.5
MLP operating room coverage	12 (Fridays)	6 (Fridays)	0	0	0	0	0	0
Cross-cover to other unit	On call for vascular service§	0	0	0	0	0	0	0
HH education/conference	3	3	3	1	0	3	3	3
Administrative tasks	3.5	5	3.5	1.5	5.75	5.5	5.5	5.5
Resident Workweek Schedule, h/Resident								
Clinic	6	6	0	0	10	0	0	0
Didactics	4	4	0	0	4	4	0	0
Operating room	15	18	0	0	38	0	0	0
Floor/emergency department coverage	38	33	0	0	15	57	0	0
HH conferences	3	5	0	0	1	5	0	0
Sign-out rounds	14	14	0	0	12	14	0	0
Total Resident Workweek	**80**	**80**	**0**	**0**	**80**	**80**	**0**	**0**

Abbreviations: HH, Hartford Hospital; ICU, intensive care unit; MLP, midlevel practitioner; SNF, skilled nursing facility and/or rehabilitation facility.

*Defined as transfers from one ICU to another, and/or an unstable patient going from the floor or postanesthesia care unit to an ICU.

†Defined as activities performed by the MLPs, such as assessing the patients; ordering, reviewing, and/or interpreting diagnostic and laboratory tests; ordering medications; following up on nutrition status; coordinating specialty consults; and updating families.

‡Defined as a patient being transferred from the ICU to the floor unit.

§Needed to operate 24 hours a day, 7 days a week.

tient population was determined by the average number of patients on the daily patient list. All other surgical divisions' patient populations were defined by an attending physician, because patients could be admitted to various patient care units.

The work effort (in hours of care) to perform service-specific patient care activities, such as consultations, discharges, admissions, and routine care (eg, assessing patients at the bedside, ordering medication, reviewing and/or interpreting diagnostic and laboratory tests, assessing and implementing nutrition, updating families, and coordinating specialty consults), was established by using a self-reporting methodology and a standard questionnaire. Physician-level patient care activities were defined by service (ICU vs floor), type (admission, discharge, or consultation), and acuity (stable or emergent) (**Table 1**). Self-reporting at our institution is a common practice used for standards building (ie, determining the number of minutes it takes to perform a test and/or service) in our cost accounting system. Verification of the accuracy of the defined work activity duration is supported through institutional productivity reports. The individual involved in administering the questionnaire had 5 years of experience with establishing productivity standards.

A subset of MLPs, postgraduate year 1 through 5 general surgery residents and subspecialty fellows (surgical critical care and vascular), were similarly interviewed. Available educational duty work hours for residents and subspecialty fellows were determined in the context of their 80-hour workweek and adjusted for educational conferences, clinic schedules, typical on-call schedules, operating room schedules, vacations, and away conferences (Table 1). The resident survey revealed the availability of an average of 49 hours per week to provide direct floor care (floor/emergency department coverage, and morning and evening sign-out floor rounds) (Table 1). Each patient care activity work effort (in hours of care) for each physician-level patient care and administrative activity was standardized (**Table 2**). The number of patient care activity hours was based on the patient census and the clinical activity time standards and was computed by taking the number of minutes it takes to perform 1 clinical activity and multiplying it by the number of clinical activities per year.

The MLP annual staffing hours available (the number of potential hours of coverage) were based on the number of budgeted full-time equivalents in fiscal year 2005. These hours were computed by the following calculation: (number of full-time

Table 2. Self-Reported Time Standards

Activity	Surgical Units, min				Surgical ICUs, min			
	Stable	Emergent	Critical	Transfer In	Stable	Emergent	Critical	Transfer In
Admissions/consults	60	120	120	90	60	180	180	180
	Routine	With Homecare	SNF/ECF	Transfer Out	Routine	With Homecare	SNF/ECF	Transfer Out
Discharge	30	90	60	NA	NA	NA	120	120
	Stable	Complex	Critical		Stable	Complex	Critical	
Routine patient care	20	60	90		60	NA	120	

Abbreviations: ECF, extended care facility; ICU, intensive care unit; NA, not applicable; SNF, skilled nursing facility and/or rehabilitation facility.

equivalents × 2080 hours per year) + [0.12 × (vacation + sick time + holiday time + replacement factor)]. The overall annual staffing hours available also include the hours spent on the patient care units by the residents and subspecialty fellows. Workforce staffing efficiency per caregiver was calculated as the number of clinical staff hours needed to provide physician-directed patient care activity divided by the number of hours of available caregiver time (MLPs, residents, and subspecialty fellows). The coverage index was computed as the total number of physician-directed staff hours available divided by the clinical coverage needs for 24 hours of operation per day, 7 days a week. The annual physician-directed coverage hours needed for 24 hours of operation per day, 7 days a week for each clinical service was determined by multiplying the number of available staff by the number of hours in a shift and the number of days per year.

RESULTS

Our department of surgery consists of 5 surgical services—general surgery, vascular surgery, cardiothoracic surgery, plastic surgery, and transplant surgery—and 3 ICUs—neurointensive care, cardiac, and general surgery. The department performs more than 13 000 surgical procedures each year. There are 116 surgical beds within the institution, of which 36 are surgical ICU beds and 12 are surgical step-down beds. Hartford Hospital is the largest teaching affiliate of the University of Connecticut Integrated General Surgery Residency Program. The program graduates 6 chief residents per year. In the study year, the 5 surgical units accounted for 14 full-time equivalents of MLPs, 16 full-time equivalents of residents, 12 282 admissions, 45 526 patient days, 12 260 discharges, and 58 049 direct patient care hours. The 3 surgical ICUs (general, neurointensive, and cardiac) accounted for 20 full-time equivalents of MLPs, 6 full-time equivalent residents, 3703 admissions, 15 158 patient days, 3710 discharges, and 59 211 direct patient care hours.

Residents and MLPs provide daily patient care and take night call on general surgery, transplant, vascular, and plastics services. There are 13 first-year internship rotations throughout the 5 hospitals of our integrated residency. In our model, the postgraduate year 1–level residents (interns) were not considered independent decision makers, because they require substantial supervision and oversight by experienced MLPs, senior residents, or subspecialty fellows to address inexperience and unfamiliarity with routines and facilities, especially early in the academic year.[7] The 80-hour workweek allows even less direct senior resident–to–junior resident apprenticeship, which is an important aspect of junior resident training. Moreover, this inexperience is further aggravated by the fact that only 49 hours per week are actually available for residents to perform direct floor work. The majority of interns will function with minimal oversight by 6 months at all 5 hospitals within our integrated residency. The 3 surgical ICUs all have MLPs, and 2 of the 3 units are managed entirely by MLPs (neurointensive care and cardiac units). The general surgery ICU has mixed coverage staffing consisting of ICU fellows, postgraduate year 1 general surgery residents, postgraduate year 2 anesthesia residents, and MLPs.

As a result of the analysis, the department of surgery assigned 4 MLPs (1 of each) to the following services: the vascular surgery service, cardiac service, cardiac ICU, and general surgery ICU. The vascular surgery service had adequate staffing (4 MLPs, 1 fellow, 1 fourth-year resident, and 1 first-year general surgery resident) to meet the patient care activity with a workload staffing efficiency index of 94% (≥90% preferred). However, the service was understaffed by 4 hours per day based on the coverage index (52% [100% preferred]). The addition of another MLP yielded an 83% workload staffing efficiency and a coverage index of 95%. The coverage index on the cardiac surgery floor with 1 MLP (and no residents) was 54% with a workload staffing efficiency index of 245%. The addition of a second MLP improved the coverage index to 104% and dramatically decreased the workload staffing efficiency index to 122% (**Table 3**). An MLP was added to the general surgery ICU, which decreased the workload staffing efficiency index from 123% to 118%; the coverage index improved from 96% to 100%. An MLP was added to the cardiac surgery ICU, and this reduced the workload staffing efficiency index to 107% from 117%; the coverage index improved to 122% from 114%. The transplant and plastic surgery services are unique services; both are staffed by MLPs and second- and third-year general surgery residents. How-

Table 3. Comparison of Workload Efficiency Index and Coverage Index, Preintervention and Postintervention

Unit	Staff Efficiency Workload, %*		Clinical Coverage Index, %†	
	Preintervention	Postintervention	Preintervention	Postintervention
Vascular surgery	94	83	84	95
General surgery	111	118	98	92
Cardiac surgery	245	122	52	104
Transplant surgery	206	206	88	88
Plastic surgery	164	164	97	97
General surgery ICU	123	118	95	100
Cardiovascular ICU	117	110	114	122
Neurointensive ICU	123	123	117	117

Abbreviation: ICU, intensive care unit.
*Ideal efficiency ≥90%.
†Ideal coverage = 100%.

ever, the number of residents varies per month based on the availability of outside resident rotators. The number of residents on the transplant service varies from 2 to 4 residents per month and on the plastic service, from 2 to 5 residents per month. These residents take call from home on both services. Budgeted MLP staffing was being supported by an annual equivalent of 6780 hours of MLP overtime and approved resident moonlighting at a cost of $405 600 for the year.

COMMENT

Given the ACGME duty-hour constraint, general surgery residents can no longer be expected to cover the entire service workload for 24 hours of operation per day, 7 days a week.[3,8] Decreasing the workload per resident by employing more preliminary residents or petitioning to expand the number of categorical residents is not easily accomplished, because the ACGME/Resident Review Committee tightly regulates the resident complement to preserve the educational quality of all training programs.[8-10]

The MLP workforce analysis resulted in the addition of 4 MLPs to achieve a favorable workforce staffing efficiency index and coverage index on all services. We adjusted MLP manpower based on the actual patient care activity, with the intent to create a high-quality, safe environment where care is provided in a timely manner. The analysis allowed us to quantitatively address patient clinical care needs while complying with the ACGME 80-hour workweek requirement. Furthermore, we were able to quantitatively understand the workload placed on the MLP staff and ensure that there were enough physician-directed resources to minimize the burden of moonlighting or being overwhelmed by the volume and/or complexity of the patient care needs, often a source of MLP and nursing staff dissatisfaction. Prior to the analysis, a sizeable portion of the institution's clinical coverage and patient care needs in the surgical service were being met by MLPs working excessive amounts of overtime and by nongeneral surgery and research residents working approved moonlighting hours. During fiscal year 2005, a total of $405 600 was spent on moonlighting and MLP overtime, covering 6700 hours. This indicated a shortage of 3.25 full-time equivalents: 1.76 full-time equivalents in the ICU and 1.49 full-time equivalents on the floor.

In 2003, the ACGME required that all accredited residency training programs comply with an 80-hour workweek restriction.[1] The typical resident work hours equation prior to July 1, 2003, was the number of hours of patient care divided by the number of residents. It is now replaced with the new ACGME-compliant patient workload equation, in which the number of hours of patient care equals the number of residents (49 hours per week) plus the number of MLPs (40 hours per week), with 49 hours per week indicating the average number of hours that a resident or subspecialty fellow is available for patient care activities.

Our department of surgery began employing MLPs in 1985. They provide direct and indirect physician-level patient care as well as function in administrative, educational, and research roles. Midlevel practitioners (physician assistants and advanced-practice registered nurses) are responsible for assessing patients (including new consults), completing histories and physical examinations, providing subsequent care for inpatients, entering orders, monitoring laboratory results, and assisting in the coordination of discharges with the case managers.[10-12] Because MLPs are required to become advanced cardiac life support certified, they respond to emergencies and can assume responsibility for resuscitating critically ill patients. Midlevel practitioners also function in the important role of resident educator.[8,11,13] This is especially true in the ICUs where the MLPs regularly teach the postgraduate year 1 residents who are rotating on the service. The presence of the MLPs ensures that the patients are provided accurate and timely information about their care.[12-15] The MLPs' presence facilitates timely patient discharges to skilled nursing facilities and ensures safe and effective continuity of care. Midlevel practitioners provide physician-level patient care services (eg, emergency department admissions and the placement of a pulmonary artery catheter in the ICU) under sanction and direction of a licensed physician. Both physician assistants and advanced-practice registered nurses must have an assigned supervising physician who is licensed within

the state, and this relationship must be documented with the state's department of public health. This statement of physician supervision is filed annually as part of the reappointment process.

The observation that the coverage index was greater than 100% at the outset in 2 services (cardiovascular ICU and neurointensive ICU) indicated that while we had a sufficient number of staff to cover 24 hours of operation, 7 days a week, the clinical workload demands were excessive. Two MLPs were reallocated from the general surgery service where an adequate number of residents (13) and MLPs (6) maintained a sufficient coverage index and workload staffing efficiency index (coverage index: preanalysis, 98%; postanalysis, 92%; workload staffing efficiency: preanalysis, 111%; postanalysis, 118%).

We created more favorable coverage and workload staffing efficiency indexes across all surgical floor and ICU services. However, we did not completely alleviate all our needs and are still dependent on a minimum amount of overtime. We are working with the hospital administration to rethink the replacement factor for MLPs to better reflect their increasing educational and administrative roles.

CONCLUSION

This study addressed the nonattending practitioner shortfall impacted by the educational duty-hour constraints under the ACGME 80-hour workweek. We devised a quantitative methodology to define the number of MLPs required to meet the department's physician-directed clinical patient care needs. The MLP workforce analysis supported the addition of 4 MLPs to achieve an acceptable workforce staffing efficiency and coverage index throughout the department's clinical services, and comply with the 80-hour ACGME resident workweek requirement. The MLP analysis quantified patient care activity manpower needs based on patient volume and complexity of the patient care activity, incorporating the availability of residents and subspecialty fellows. We established a supportive and manageable work environment for our MLPs, a workplace condition that is increasingly important to their recruitment and retention in today's competitive job market.

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DISCUSSION

Thomas Tracy, MD, Providence, RI: This analysis, again, was another great presentation by your group and I want to take up your last comment, because I am sure you are too politic to really expand on it. This is sort of the same phenomenon we have seen for "the first pigs at the trough." You can present all of these numbers, yet these resources will be given to those services that can provide dollars to the bottom line where there is a return on investment for every midlevel practitioner. Were you able to demonstrate by these very clear-cut hour demands that even a service that had less return on investment deserves more man-hours as the best thing for patients rather than for dollars?

Dr Kirton: We have focused on retention and recruitment of MLPs and the satisfaction of residents on the service. In terms of financial return, our midlevel practitioners capture all appropriate billing opportunities. The billing is much more robust in the intensive care unit, less so on the floor. In summary, we have focused on financial return and the quality of the environment as a way to justify the addition of the MLPs.

George Lipkowitz, MD, Springfield, Mass: I enjoyed both this and the previous paper. The one thing that worries me, as I think was pointed out previously, is at some point the hos-

pitals are going to say they do not have the money to supply the additional MLPs or whatever you want to call them at this time, and everything else in the system is fixed, we are not going to have less work hours as far as the patients' needs, so the only thing that has any give in the system, which is not included in either analysis, is the number of work hours of the attending physicians. That, of course, is going to reach a limit at some point and has in some places already. I do not see any other give in the entire system, because in Massachusetts most of the hospitals already are losing money. Going to the administration to say that you want MLPs who do not come close to paying for anything in what they can actually bill leads you to believe that the attendings will keep having to work more and more until they cannot work anymore either. I do not see where the way out of the system is going to occur.

Dr Kirton: I cannot agree more wholeheartedly. This is a very difficult time I am sure for all of us who are in teaching institutions, and particularly those of us who are program directors.

Thomas Colacchio, MD, Lebanon, NH: I wanted to congratulate both you and Chip for these very, very provocative papers and for your thoughtful way of bringing quantification into the evaluation of this problem.

One suggestion I have, in terms of trying to develop a case to discuss with hospital administration, is to use the leverage point of decreasing the length of stay and thereby the cost of care and thus increasing the number of admissions with the same number of beds. Utilizing this as a goal for increasing your workforce may be very effective. The second point is obviously patient satisfaction and having the capacity to focus on this, because it is very important for all of us but especially for hospital administration. Finally, there are the issues around safety and the reduction in complication rates that are hopefully going to be gained by increasing in your staffing. I wonder if you have thought through how you can begin to introduce these variables into your equation.

Dr Kirton: Those are important variables and I think those are the ones administration will listen to—length of stay, patient satisfaction, which is on everyone's front door, but obviously patient safety. We are going to have to look at these measures to justify additional resources.

Anthony Morgan, MD, Hartford, Conn: Orlando, a few months ago we talked about changing educational teaching of our residents at St Francis and Hartford Hospitals, John Dempsey, and also the New Britain General. I suggested to our peers and to our residents one thing some people found outlandish: nonteaching services. Not every attending at Hartford or St Francis, etc, is a good teacher. Good surgeons, perhaps not good teachers. So my cry for all of us is, how do I put this? Isolate the good teachers. Train the residents well. Our midlevel practitioners at St Francis are excellent practitioners and excellent also educators, believe it or not, particularly in the ICU. It may be an outrage to hear this, but at St Francis our midlevel practitioners are training our junior residents in the ICU and they are doing a very good job. That is one factor, but I will repeat again, not everyone at Hartford, St Francis, John Dempsey, New Britain is a good teacher. Good surgeons but not good teachers.

Dr Kirton: Thank you, Dr Morgan. There is always the question about teaching and nonteaching services. At our institution, Hartford Hospital, such discussion is always contentious because everyone considers themselves excellent teachers and no one wants to be assigned to the nonteaching service, so there is a lot of resistance to creating that type of teaching faculty model.

Robert Quinlan, MD, Worcester, Mass: I would say that going to administration is probably going to be only part of the solution in the future. One needs to deal with the public and the legislature. The administration has built a bureaucracy which we support. I learned just recently our CEO [chief executive officer] of 10 000 employees and 1000 physicians 2 years ago had a reported salary of $1.3 million. Monies for health care are running out. I think we have to go to others as well as administration with our story of monies for provider support.

Dr Kirton: I agree. Thank you for those comments, sir.

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