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Resident Efficiency in a Pediatric Emergency Department

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Abstract

Objectives: To measure the hourly rate of patients evaluated and treated by resident physicians in an academic pediatric emergency department (PED) and examine differences in the rate by subspecialty and year of training. **Methods:** For all residents rotating in an academic, urban children's hospital PED, the rate of patients seen per hour over the course of their rotation was calculated using an electronic tracking system, EmSTAT, for calendar year 2000. Rates are reported as the mean number of patients seen per resident hour worked. Mean differences are reported for resident subspecialties (emergency medicine, pediatrics, and family practice) and postgraduate year (PGY1–PGY3), and subclass comparisons were made with an analysis of variance test with Tukey's post hoc analysis. **Results:** A total of 153 residents (63.4% pediatric, 18.9% family practice, and 17.7% emergency medicine) saw 24,414 patients during the study period. The makeup of the group by training year was as follows: PGY1, 20.9%; PGY2, 41.2%; and PGY3, 37.9%. For all residents, the mean rate was 1.02 patients

seen per hour (pph). Significant differences in the mean number of patients seen per hour by subspecialty existed, with emergency medicine residents seeing a mean of 1.12 pph, pediatrics residents seeing 1.02 pph, and family practice residents seeing 0.93 pph (mean difference, $p < 0.05$ for all comparisons). Rates increased by year of training, with PGY1 seeing a mean of 0.95 pph, PGY2 seeing 0.99 pph, and PGY3 seeing 1.09 pph (mean difference, $p < 0.05$ for all comparisons except PGY1 vs. PGY2). **Conclusions:** Significant differences in the rate of patients evaluated and treated in the PED exist by resident subspecialty and year of training. Knowing these rates is helpful in evaluation of resident performance, because it allows comparison with peers. Additionally, such information may be useful for residency program evaluators to gauge the amount of patient exposure for residents. **Key words:** residency training; efficiency; medical education. *ACADEMIC EMERGENCY MEDICINE* 2005; 12:1240–1244.

Efficiency is an important measure in emergency medicine for the assessment of both individual physician and system performance. How efficient a resident is in clinical care is a common topic during resident evaluation and, for the most part, such performance evaluations are subjective. A more objective approach to assess efficiency is needed, especially for centers training residents from a variety of different specialties. A better method for determining physician efficiency, measuring by numbers of patients evaluated and treated per unit time, may also serve as a useful tool in planning the staffing of the emergency department (ED).

Previous studies performed in general EDs have indicated that the number of patients seen per hour by a resident differs by year of training.^{1–4} Rates of

patients seen per hour have been documented to be between 0.5 and 1.2 for emergency medicine residents in a general ED.^{1–4} Studies that examine rates in pediatric settings are few and not contemporary.⁵ A single study examined differences in resident efficiency between subspecialties; although differences in rates were seen, they were not statistically significant.⁶

The present study sought to measure the rate of patients evaluated and treated per hour by residents in an academic pediatric emergency department (PED) and to determine if that rate was associated with year of training or resident specialty. Additionally, we sought to determine if patient acuity mix influenced the rate of patient workup.

METHODS

Study Design. This was a retrospective observational study using a data set generated by EmSTAT, an electronic patient tracking system designed for EDs.⁷ Data for one calendar year, January 1, 2000, to December 31, 2000, were analyzed. The study qualified for exempt status from the institutional review board at the Children's Mercy Hospital.

Study Setting and Population. The study was conducted in an urban, academic ED of a midwestern

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children's hospital with an annual census of 55,000. There were 13 full-time attending physicians and six full-time pediatric emergency medicine (PEM) fellows working in the institution at the time of the study. Residents from the hospital's pediatric program (program year [PGY] 1–3), one emergency medicine (PGY1–3) program, and three family practice (PGY2–3) local training programs routinely rotate through the ED. Additionally, a number of nonlocal residents and medical students take an elective in the department. The number of PEM rotations required during the three years of training varied by subspecialty, with four months required for pediatrics, three months for emergency medicine, and one month for family practice. All residents received a standard orientation to the department. At the time of the study, the ED was staffed 24 hours per day by at least one (and up to three) supervising, board-certified PEM attending or PEM fellow physicians and from one to six resident physicians. All residents presented all cases to a supervising attending physician or fellow who also saw the patient. Visits primarily seen by residents during a PEM rotation were included in the study. Residents were scheduled from 14 to 17 shifts during their four-week rotation (average of 16 shifts). All shifts were ten hours long. Residents from all PGY levels and subspecialties worked morning, evening, overnight, weekday, and weekend shifts with the exception of family practice residents, who did not work overnight shifts. For the purposes of this analysis, patient visits seen by attending physicians alone, external services (pediatric surgery, orthopedics), residents not primarily on a PEM rotation, medical students, and nurse practitioners were not included. Residents were not assigned specific patients. Patients were picked up in order of triage by the next available resident, regardless of the resident's specialty or year of training, with some exceptions. Family practice residents did not routinely evaluate child maltreatment or major trauma. Additionally, care of child maltreatment and major trauma required specific training that was acquired by pediatric and emergency medicine residents early in their first year. Residents' duties consisted solely of direct patient care, and they were not responsible for supervising more junior residents or medical students.

Study Protocol. The data set extracted from EmSTAT included date and time of visit, acuity level, physicians' mnemonic codes, and patient disposition. The acuity levels included emergent (to be seen within 20 minutes), urgent (to be seen within two hours), and nonurgent (could wait until the next day). The number of patients evaluated and treated by a resident during an approximately four-week rotation in the ED was extracted from EmSTAT. This number was divided by the number of actual hours worked in the

ED during the rotation. The number of hours was kept by the physician in charge of resident scheduling (CT), who tracked resident absences due to illness or other obligations. If a resident finished a shift and transferred the care of the patient to another resident, the patient was credited to the last resident caring for that patient before discharge. Data over one year were accumulated by total group, subspecialty, and year of training.

Data Analysis. Descriptive data are presented as means \pm SD. Between-class comparisons of means were performed with an analysis of variance test and Tukey's honestly significantly different post hoc analysis. Mean differences for each comparison are presented with corresponding 95% confidence intervals around the mean differences. A p-value of <0.05 was set as statistically significant. To assess the effect of acuity mix, we repeated the analysis using a weighting procedure based on triage category with a weight of 3 for emergent, 2 for urgent, and 1 for nonurgent. For the weighting procedure, the number of patients seen for each triage category by a given resident was multiplied by the corresponding acuity weight. After adding the resulting numbers together and dividing by the actual number of hours worked by a resident during that time, we performed the above statistical analysis to assess relationships between means.

RESULTS

Resident Characteristics. A total of 153 residents were included in the study. Slightly more than half (54.2%) were female, with pediatrics, family practice, and emergency medicine residents representing 63.4%, 18.9%, and 17.7% of the sample, respectively. Residents in the PGY2 year made up 41.2% of the group, while PGY3 and PGY1 comprised 37.9% and 20.9% of the group, respectively. Proportions of PGY level are noted in Table 1. The mean (\pm SD) number of hours a resident worked during a four-week rotation was 155 (\pm 23.7).

Visit Characteristics. For calendar year 2000, the ED census was 50,361; 24,414 patients (48.5%) were seen by residents and included in the study. Of the visits in

TABLE 1. Subspecialty and Year of Training of Residents Studied (N = 153)

Specialty	Year of Training n (%)			Total
	PGY1	PGY2	PGY3	
Emergency medicine	10 (6.5)	8 (5.2)	9 (5.9)	27 (17.6)
Pediatrics	22 (14.4)	36 (23.5)	39 (25.5)	97 (63.4)
Family practice	NA	19 (12.4)	10 (6.5)	29 (18.9)
Total	32 (20.9)	63 (41.2)	58 (37.9)	153 (100)

TABLE 2. Mean Differences in Patients Seen per Hour by Resident Year of Training and Subspecialty

		Mean Difference	95% CI	p-value
Specialty (mean pph)				
Emergency medicine (1.12)	Pediatrics	0.100	0.018, 0.184	0.01
	Family practice	0.196	0.094, 0.298	<0.001
Pediatrics (1.02)	Emergency medicine	-0.100	-0.184, -0.018	0.001
	Family practice	0.095	0.014, 0.175	0.02
Family practice (0.93)	Emergency medicine	-0.196	-0.298, -0.094	<0.001
	Pediatrics	-0.095	-0.175, -0.014	0.02
Postgraduate year (mean pph)				
PGY1 (0.95)	PGY2	-0.052	-0.136, 0.031	0.31
	PGY3	-0.141	-0.226, -0.057	<0.001
	PGY1	0.052	-0.031, 0.136	0.31
PGY2 (0.99)	PGY3	-0.089	-0.159, -0.019	<0.01
	PGY1	0.141	0.057, 0.226	<0.001
PGY3 (1.09)	PGY2	0.089	0.019, 0.159	<0.01

pph, patients seen per hour.

the study, 11.6% were emergent, 64.8% were urgent, and 23.6% were nonurgent. A total of 2,948 visits (12.1%) resulted in admission to an inpatient unit. A total of 15,518 patients (63.6%) were seen by pediatric residents, 5,109 (20.9%) by emergency medicine residents, and 3,787 (15.5%) by family practice residents.

Rate of Patients Evaluated and Treated. The mean (\pm SD) number of patients seen per hour (pph) by the total group was 1.02 (\pm 0.17), with a range of 0.62 to 1.65. There were no significant differences in number of patients seen per hour by gender of the resident. Rates varied significantly by subspecialty type, with emergency medicine residents seeing 1.12 pph (SD \pm 0.19), pediatric residents seeing 1.02 pph (SD \pm 0.16), and family practice residents seeing 0.93 pph (SD \pm 0.13). As detailed in Table 2, differences among the means were statistically significant for all subspecialty comparisons ($p < 0.05$).

An analysis by year of training revealed a significant increase in patients seen per hour; the mean (\pm SD) pph for PGY1 was 0.95 (\pm 0.14), for PGY2 was 0.99 (\pm 0.17), and for PGY3 was 1.09 (\pm 0.17). As detailed in Table 2, differences among means were significant ($p < 0.05$) between each level of training except between PGY1 and PGY2 ($p = 0.30$). A sub-analysis, taking into account both year of training and subspecialty type, was performed and the results (means and 95% CI) are summarized in Figure 1. Within each subspecialty, patients seen per hour increased by PGY level. Statistically significant increases were appreciated by PGY year for the pediatric subgroup but not for either emergency medicine or family medicine.

The same patterns of increase and statistical comparisons for the mean number of patients seen per hour by year of residency training and subspecialty were noted after the weighting procedure for acuity was applied (data not shown).

DISCUSSION

Similar to studies conducted in general EDs, we found that the rate of patient encounters by residents in a PED increased significantly with each year of training.¹⁻⁴ We also found that there were significant differences in the number of patients seen per hour between emergency medicine, pediatric, and family practice residents. A previous study examined differences in rates of patients evaluated and treated by subspecialty but did not find significant differences, perhaps due to a small sample size.⁶ Most studies have examined rates of patients seen by emergency medicine residents in general EDs,¹⁻⁴ and rates for emergency medicine residents in the current study are remarkably similar to those previously reported. Although comparison of rates within subspecialties demonstrated an increasing rate throughout residency

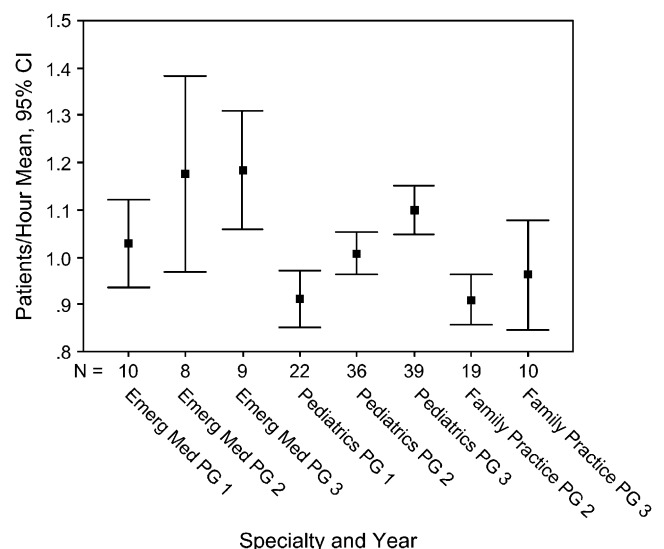


Figure 1. Mean rates of patients seen per hour, by resident subspecialty and year of training.

training for each subspecialty (Figure 1), small numbers precluded reliable comparison.

Comparisons with other studies in PEDs are limited to a study by Lamb et al. who, in the early 1970s, calculated the rate of patients seen in a PED.⁵ Interestingly, in that study, the calculated number of patients seen by pediatric interns per 24-hour shift in the PED was 22.6, or 0.94 pph, which is nearly identical to our results for pediatric PGY1 residents.

It is understandable that efficiency (as measured by rate of patients seen per hour) increases for each year of residency training, due to increases in knowledge and experience. However, the reasons for differences between subspecialties are less clear. In the current study, emergency medicine residents demonstrated greater efficiency in the PED than either pediatric or family practice residents. Such differences may be attributed to residency training differences. There is a greater emphasis given to anticipatory guidance, psychosocial aspects of the family, and preventive counseling in primary care specialties such as pediatrics and family practice. Emergency medicine training takes place primarily in environments with high patient volumes and high acuities, making development of multitasking and efficiency natural priorities.

Reasons for the subspecialty efficiency could also be extrinsic, meaning differential exposure to lower volume of patients, higher-acuity patients on the basis of scheduling, or differential responsibilities. Throughout their training, residents of all subspecialties have increasing responsibilities as they are exposed to specific educational programs, for instance, care of multiple trauma and child abuse. Given that the number of patients seen per hour increased during the progress of residency training, taking on additional responsibilities does not seem to have the effect of lowering efficiency, but quite the contrary. Future studies that explore the relationship between efficiency and responsibilities would be enlightening. Types (time of day, day of week) of shifts and numbers of shifts were similar among residents. However, the family practice residents in this study did not work overnight shifts and worked when a greater number of residents were on duty, thereby potentially lessening their exposure to patients. In our department, overnight shifts have the lowest patient volume of any shift, so it is unlikely that this scheduling difference was influential. Last, those with the least amount of exposure to the PED, such as family practice residents who rotate for only one month during their three years, have less familiarity with the ED and its functioning, which is likely to negatively impact their efficiency.

LIMITATIONS

There are several limitations to this study that must be mentioned. We do not account for PED patient

volume, which varies by time of day, day of the week, and season. Patient volume can influence the rate at which patients are seen by limiting resources such as nursing staff and rooms in which to see patients. Patient complexity also influences the number of patients per hour a resident is able to evaluate and treat. Although we attempted to examine the effect of severity of illness by performing an analysis weighted for triage acuity, this crude adjustment may not completely account for patient complexity. Because the analysis was cumulative and over an entire year, and all subspecialties and postgraduate levels worked year-round and had similar responsibilities, we believe that these factors may equilibrate among the group. Additionally, we were not able to account for the time the resident spends discussing the patient with the supervising attending physician, which varies among supervising physicians. It is likely that the time spent "checking out" a patient to an attending physician decreases as training year increases. Last, our experience is only that of one center, so caution must be taken in interpreting for other regions.

CONCLUSIONS

The calculation of rate of patient workups by subspecialty type and year of training helps us to set more objective standards for one aspect of resident efficiency. It allows comparison with subspecialty and training-year peers and allows tracking of one measure of performance over the course of a resident's training. This is important, because reliability studies of clinical evaluations by faculty in the ED have demonstrated significant variability in scoring patterns.⁸

Because the residency programs for all subspecialties are implementing the competency-based training standards described by the Accreditation Council for Graduate Medical Education, it is necessary to have measurable benchmarking data.^{9,10} However, we feel strongly that measures of patient workup should never be considered in isolation and should be viewed in context and with other qualitative measures of patient care. Another possible use of these data could be by program evaluators from the resident review committees to gauge amount of patient exposure per resident for a given program.

On a final note, the differences observed in this study, although statistically significant, are relatively small; for instance, a difference of 0.1 pph is, on average, only one patient per ten-hour shift. However, when viewed from a cumulative perspective, this translates to an additional 16 patients in the typical month-long rotation, which represents a significant opportunity for education. Future studies of physician efficiency should take into account other measures,

such as patient throughput time and relationship of any measure of efficiency to factors potentially affecting efficiency, such as daily or shift census, time of day, or season. A critically important area for investigation is the relationship between measures of efficiency and quality measures, such as patient clinical outcome, safety, and satisfaction with care.

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