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Emergency Medicine Resident Work Productivity and Procedural Accomplishment

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The purpose of this study was to assess procedural accomplishment, work productivity, and efficiency for emergency medicine residents in a community-based, osteopathic emergency medicine residency. These data are compared with limited existing data from other training sites.

The authors conducted a retrospective analysis of patient-encounter data logged into a computerized mainframe database over 8 years by 19 resident physicians. Only data from residents who had complete logs for all 3 years of residency were included. Procedures and diagnoses were from the core content areas defined in the basic standards for approval of residency training programs in emergency medicine.

Approximately 98,000 patient encounters were logged during the study period. First-year emergency medicine residents saw an average of 1.06 patients per hour, second-year emergency medicine residents an average of 1.33 patients per hour, and third-year emergency medicine residents an average of 1.41 patients per hour. Residents performed an average of 65 intubations, 533 adult resuscitations, 144 pediatric resuscitations, 49 central line insertions, 47 lumbar punctures, and 280 laceration repairs.

Residents tend to see more patients per hour as their training progresses. Residents in this program get significant experience in some procedures but little or no clinical exposure to other procedures. These results are consistent with the few other published reports attempting to quantify the emergency medicine resident experience. The data may assist in setting clinical objectives and establishing uniform tracking systems and coding terminology.

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A primary objective of residency training in emergency medicine is developing procedural competency and efficiency in attending patients. Of the many parameters that may be used to determine readiness to graduate, the number of procedures performed and an individual's graduated increase in productivity are two measurable endpoints. Measuring such proficiency, however, has proved to be a nebulous task. Recording the number of procedures performed and the number of patients seen per hour has variously been done to quantify the resident experience and thus imply efficiency and competency.[1-8] We believe this study is the first to quantify these parameters for a community-based osteopathic emergency medicine residency program.

Currently, there are no requirements for the minimum number of patient encounters or procedures during emergency medicine residency training. Both the American Osteopathic Association (AOA) and the American Board of Emergency Medicine have determined that a minimum of 3 years of emergency medicine training provides the necessary clinical experience for proficiency.[7,9,10] Despite the fact that no minimum standard exists, the AOA requires documentation of "the volume, variety and scope...for emergency cases and procedures."[10] Likewise, the Residency Review Committee for Emergency Medicine (RRC-EM) has identified sixteen procedures and four types of resuscitations that allopathic emergency medicine residents are required to document.[7] At present, minimum performance criteria have not been established for these procedures. Despite this, employers are increasingly requiring such documentation before extending job opportunities or hospital privileges.[2,3,6]

Methods

We conducted a retrospective analysis of patient-encounter data collected over 8 years from 19 resident physicians between 1989 and 1996. Because the study was a retrospective data analysis, it was considered exempt from informed consent. The study site was the Michigan State University College of Osteopathic Medicine's emergency medicine residency program. The duration of training for this program is 36 months. The program is accredited by both the AOA and the Accreditation Council for Graduate Medical Education for emergency

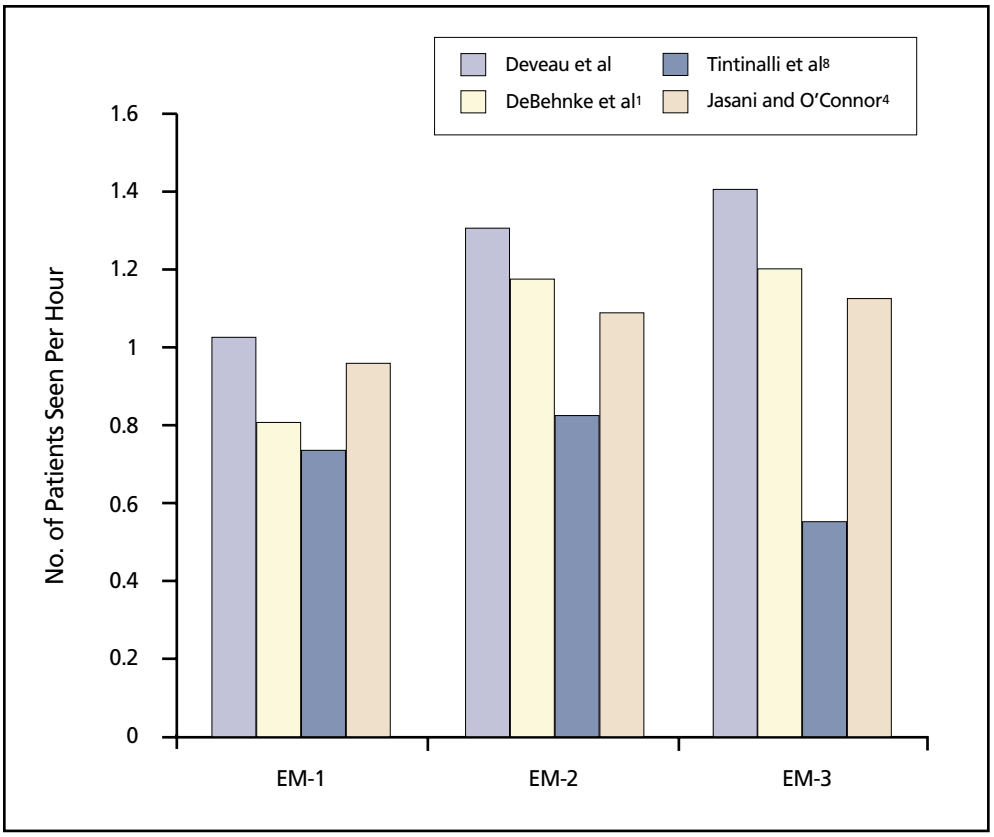

Figure. *Average number of patients seen per hour by emergency medicine residents, as reported in various studies. EM-1 indicates first-year emergency medicine residents; EM-2, second-year emergency medicine residents; EM-3, third-year emergency medicine residents.*

medicine residency training and is composed of osteopathic and allopathic emergency medicine residents. Only osteopathic residents participated in the study, as only they were required to log all patient encounters. All osteopathic emergency medicine residents had completed a traditional rotating internship before residency.

As first-year emergency medicine residents, osteopathic emergency medicine residents completed from four to six (depending on the year the data were from) 4-week emergency medicine rotations. This varied from the two 4-week emergency medicine rotations for allopathic first-year emergency medicine residents in this residency. During the study period, there were 57 residents in the program, 21 of whom were osteopathic residents. Data from 19 of the 21 residents were used because only those residents who completed data entry for all 3 years of residency training were included.

Clinical rotations were at two university-affiliated, community-based campuses in Lansing, Michigan. Each resident in the study had a similar clinical experience, as all residents spent the same number of months in the emergency department of each institution. Patients were seen at Sparrow Hospital, a 503-bed tertiary referral and trauma center, and at Ingham Regional Medical Center, a 363-bed facility. Sparrow Hospital had a mean annual emergency department census of 50,346 during the study period, with 27.46% of these being pediatric visits. Ingham Regional Medical Center's mean annual emergency department census was 33,138, with 16.42% of these being pediatric encounters.

All osteopathic residents were required to log all patient encounters into a computerized mainframe database located at Michigan State University. Some residents chose to have software installed on their personal computers by the residency program, allowing them to perform data entry from home. There were no requirements for how residents would maintain their records, but most made an Addressograph imprint or obtained a copy of the emergency department record. A list of 123 procedures and 845 diagnosis codes was provided to each resident. The list was derived from the core content areas defined in the basic standards for approval of residency training programs in emergency medicine.[10] Each entry required the hospital site, the patient's history number, date of birth, gender, date of visit, and procedures and diagnoses.

Standard descriptive statistics were used to determine the mean number of patients attended by first-, second-, and third-year emergency medicine residents as well as the frequency of each diagnosis and procedure. Each patient may have multiple diagnoses or procedure codes. The number of patients seen per hour was derived by obtaining each resi-

dent's schedule and selecting only patients seen during months spent in the emergency department and dividing by the number of hours spent working. Data for procedures may include those performed on clinical rotations outside of the emergency department.

Results

The *Figure* demonstrates that first-year emergency medicine residents saw a mean of 1.06 patients per hour; second-year emergency medicine residents, a mean of 1.33 patients per hour; and third-year emergency medicine residents a mean of 1.41 patients per hour. These data include only patients seen during emergency medicine rotations for which the resident had primary responsibility. For senior residents, the data do not include patients that they staffed with junior emergency medicine residents, interns, or students. Included for comparison are recently published data from other studies.[1,4,8] Data included for comparison may have used different data collection methods, but measured the same endpoint, ie, the number of patients seen per hour according to residency year.

The mean number of various procedures performed by each resident is presented in the *Table* and compared with other published data.[2,3,5] Each resident performed an average of 65.2 intubations, 532.6 adult resuscitations, 144.4 pediatric resuscitations, 48.7 central line insertions, and 47 lumbar punctures. The computer program does not differentiate successful procedures from unsuccessful attempts, so data may represent both, depending on how the resident logged the encounter. All results represent mean values per resident during 36 months and may include procedures from non–emergency medicine rotations. No data from osteopathic internships are included. Again, comparison data may have used different data collection methodology but had similar endpoints, ie, the quantification of various procedures performed by residents during their residency training.

Discussion

As the *Table* and *Figure* indicate, the data from this study are generally consistent with other published reports on procedural volume and patients seen per hour.[1-6,8] The data from this study show that as residents progress in their training, they are able to see more patients per hour, seemingly indicating greater efficiency. No data were compiled regarding acuity of patients seen or admission rates based on resident year. In this program, all residents see a similar population of patients. There are no designated assignments for which type of patients second- and third-year emergency medicine residents are expected to manage, so residents would theoretically see similar levels of acuity. Residents are expected to assume increasing responsibility as they progress through their training and so it is expected they would see more patients. However, as residents progress, it is expected that they are able to more efficiently work through more "routine" cases, thus creating more time to deal with higher-acuity problems.

The RRC-EM has specified 20 procedures that residency programs are required to maintain documentation for, thus providing the basis for selecting the procedures presented in the *Table*.[7] The data indicate that residents were provided ample exposure to a number of critical procedures in which emergency physicians are expected to be proficient. The data also show a disproportionately higher number of both adult and pediatric resuscitations than in other published data. This may be attributed to several factors. It is possible that different institutions use different definitions of "resuscitation." For procedure logs at this residency, resuscitation was defined as the necessity of prolonged physician attention at the bedside; interventions such as defibrillation, cardiac pacing, treatment of shock, use of thrombolytics, vasopressors, or neuromuscular blocking agents; and invasive procedures such as central line insertion, tube thoracostomy, intubation , and cutdowns. These data may also include procedures from non–emergency medicine rotations and procedures the residents directed or oversaw. For pediatric resuscitations, the data include all of the above in addition to patients requiring multiple intravenous fluid boluses regardless of whether the patients were ultimately admitted or discharged. Last, the data include patients who may have been managed jointly with trauma surgery or pediatric services.

The data also demonstrate that there are procedures most residents only get limited experience performing. Cricothyrotomy, diagnostic peritoneal lavage, pericardiocentesis, thoracotomy, transvenous pacemaker insertion, and tube thoracostomy are examples of procedures for which most emergency medicine residents report only limited experience. This appears to be a universal problem not limited to the institutions of this study.[3]

Several studies have attempted to document the procedural experience of emergency medicine residents.[2-6,11] Langdorf et al[5] documented procedure performance of 24 residents over four graduating classes by means of individual log sheets that were submitted and entered into a computerized database. Dire and Kietzman[2] collected data from one class cohort over 36 months, with each resident responsible for entering his or her procedure data into a centrally located computer. Data from both of these studies are presented for comparison and indicate similar difficulty obtaining adequate experience with some procedures.

Data from Hayden and Panacek[3] may be particularly useful for comparison because the findings represent the average number of procedures per graduating resident for 65 of 112 approved programs as of January 1997. They reported few differences in emergency medicine resident procedure experience regardless of practice setting, emergency department volume, or program format. However, they also reported limited experience for essentially the same set of emergency department procedures the other reports had low yields for. This would seem to indicate that most emergency medicine residency programs are faced with the same

dilemma of requiring alternative measures for obtaining this experience. Such methods may include the use of animal or cadaver labs or computer-simulated models.

Despite the data by Hayden and Panacek[3] indicating similar procedural experience among most residents, significant differences in experience for some procedures between programs may still be observed. These may be due to differences in procedure reporting between programs rather than differences in the opportunity to perform them. For example, does the program encourage all procedure attempts to be entered or only those that were successfully performed? Does it discriminate between resuscitations directed or performed? How does the program define *resuscitation*? For truly meaningful comparisons to be made, guidelines for standardization of these issues need to be established.

The data derived in this study are entirely self-reported by each resident. Hayden and Panacek[3] found this to be the case for most programs in their analysis. While the potential for overreporting procedural experience exists, we agree with their assertion that the data for critical procedures are probably reasonably accurate because residents more closely track these procedures, as opposed to commonly performed or less critical procedures, such as laceration repair. In addition, there would be no benefit to artificially inflating procedural experience because there are no RRC-mandated minimum requirements for such procedures. The Michigan State University emergency medicine residency likewise has no minimum requirements.

We believe the data on the number of patients seen to be underreported. There is no intrinsic reward for inflated productivity data as it is not disclosed to residents, nor is it used in their evaluation or as a promotional tool. Our anecdotal experience indicates that residents do not embrace spending off-duty time tracking patient encounters. They are thus less likely to spend time and effort on logs, particularly for cases perceived to be more commonly seen or less severe. Additional anecdotal evidence indicates that senior residents in particular are less likely to maintain accurate records of "routine" cases. This may be responsible for second- and third-year residents having similar patient volumes. The raw data for this study seem to support that fact when looking at the last several months of data of some of the senior residents (when the number of patients seen drops off dramatically despite higher emergency department volumes). At the time these data were collected, no method existed to monitor resident compliance with patient tracking, which may also have contributed to underreporting.

Some specific changes in the process have been made as a result of this study. A new field has been added to the computer program to determine whether the patient was seen in the emergency department or on outside rotations. A new field for intensive care admissions has also been instituted. Efforts are currently under way to integrate the existing system with handheld personal computers. These changes should allow more convenient and efficient data entry, which may translate into more accurate data collection.

The results of this study are promising in that they seem to indicate residents are able to increase the efficiency with which they see patients as they progress through their residency. This satisfies one of the primary goals of residency training. The data also indicate significant experience in some procedures and little to no exposure to other critical, potentially life-saving procedures. But does performing a certain number of a given procedure ensure competency? How many of each procedure is enough, and how should that number be determined? Establishing minimum performance criteria for procedures and patient encounters cannot ensure competency, but it would help determine reasonable goals for these parameters to be obtained during residency training. It would also allow programs that are deficient in certain areas to augment resident training to meet minimum criteria. Before this could be done, however, uniform terminology should be established so that each program is measuring the same parameter.

There were several limitations to our study that may have influenced the data. Most of these were related to how the data were compiled by each resident. There was no uniformity regarding how residents maintained their logs. Most made a copy of the emergency department record and entered the data into the database themselves. Some residents hired data entry services to log the data for them after they had determined the diagnoses and procedures. Others hired services familiar with billing processes to read through the record and determine appropriate diagnoses and procedures and enter them into the database. This lack of uniformity may have contributed to discrepancies in the totals of each resident.

Although the RRC-EM has defined procedures and scenarios for resuscitations, these were not included in each resident's list of procedures and diagnoses (it was explained to them at an orientation session detailing patient tracking and logging procedures). This may have contributed to error by not having a clear definition of what constitutes a medical resuscitation. Also, no definition regarding what constitutes a trauma resuscitation was made. It is possible the data may include patients evaluated in the emergency department in conjunction with the trauma surgery team under a "trauma alert" due to the mechanism of injury—patients who were ultimately discharged with only minor injuries such as contusions. This would artificially inflate trauma resuscitation totals.

Unfortunately, at our institution, there are no efficient means of monitoring resident compliance with their patient encounter logs. As mentioned previously, this program requires osteopathic residents to track all patient encounters as well as procedures. Dictation or electronic documentation would allow a more practical means of tracking resident compliance. Compliance could be determined by comparing the number of charts generated by each resident with the number of patient encounters logged for that resident. Alternatively, a system to integrate the processes of documenting each

Table
Average number of procedures performed by emergency medicine residents, reported from various studies

Procedure	Deveau et al	Hayden and Panacek[3]	Langdorf et al[5]	Dire and Kietzman[2]
Intubation				
Oral	40.1	65	60	19
Nasal	12.8	6	4.3	13
Unspecified	12.3	75	NR	NR
Adult medical resuscitation	375.5	107	72.3	67*
Adult traumatic resuscitation	157.1	74	53.9	NR
Pediatric medical resuscitation	99.5	19	12.1	NR
Pediatric traumatic resuscitation	44.9	13	7.3	NR
Central line insertions	48.7	55	74.4	23
Lumbar puncture	47	39	38.7	62
Chest tube insertion	8.5	17	23	8
Transcutaneous pacemaker	2.8	6	NR	6
Transvenous pacemaker	2.6	2	NR	3
Cricothyrotomy	1.2	2	0.63	2
Cardioversion/defibrillation	6.5	NR	NR	11
Thoracotomy	2.1	3	1.5	5
Pericardiocentesis	1.8	5	2	4
Diagnostic peritoneal lavage	0.8	8	10.1	10
Laceration repair	279.7	147	48.4	NR
Vaginal delivery	7.3†	17	10.3	NR
Arthrocentesis	2.1	11	NR	4
Closed fracture reduction/splinting	80.9	25	18.5	NR
Dislocation reduction	18.2	17	4.2‡	7

*Represents totals.
†Does not include deliveries done on obstetric rotation.
‡Represents shoulder dislocations only.
NR indicates not reported by authors.

patient's emergency department course and tracking resident procedures and encounters would be ideal. However, because these processes serve fundamentally different purposes, such a merging may be difficult to coordinate.

No data were compiled regarding acuity or admission rates based on resident year. These factors have the potential to bias the data in a number of ways. If a resident or cohort of residents (ie, second- or third-year residents) sees higher-acuity patients and has a higher admission rate, that may influence the number of patients the resident is able to see. In this study, the data indicate progressively more patients are seen per hour as residents gain more experience. By logging patient acuity and tracking admission rates, one would be better able to determine the significance of differences regarding the number of patients seen per hour.

Conclusions

Osteopathic residents in the Michigan State University–affiliated emergency medicine residency program perform a significant number of procedures. The data from this study are consistent with other data and indicate that for some procedures, considerably greater exposure is provided. Data

regarding the number of patients seen per hour are favorably compared with existing data. This indicates that residents become more efficient seeing patients as they progress through their residency, evidenced by seeing a greater number of patients per hour. There is no reason to suspect that allopathic residents in this program have had a different clinical experience, especially in the final 2 years of training, when all residents work the same number of months in the emergency department.

It is recommended, however, that for truly meaningful comparisons to be made, uniform tracking guidelines and procedure terminology should be devised for all emergency medicine residency programs. This may prove useful in establishing goals for resident procedural accomplishment, efficiency, and readiness to graduate.

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