Received: 14 April 2023 | Revised: 13 September 2023 | Accepted: 18 September 2023

DOI: 10.1002/aet2.10922

ORIGINAL CONTRIBUTION

Defining the clinical and procedural opportunities available to residents during rural rotations

Brandon Haefke MD[1] | Daniel Scholz MD[2] | James (Jim) Homme MD[2] | Derick Jones MD[2]

[1]Emergency Department, Neosho Memorial Regional Medical Center, Chanute, Kansas, USA

[2]Department of Emergency Medicine, Mayo Clinic, Rochester, Minnesota, USA

Correspondence
Brandon Haefke, Emergency Department, Neosho Memorial Regional Medical Center, Chanute, KS 66720, USA.
Email: brandon_haefke@nmrmc.com

Abstract

Introduction: Many emergency medicine (EM) residency programs include clinical rotations in rural emergency departments ("rural rotations") as part of their curriculum. These rotations are designed to expose residents to clinical scenarios that are less frequently encountered in tertiary centers. The objective of this study was to determine the rate at which residents were exposed to certain clinical and procedural experiences (CPEs) while on rural rotations compared to their usual academic training hospital.

Methods: We conducted a retrospective chart review of all patient encounters involving EM residents at a large academic hospital in Rochester, Minnesota, compared with two rural hospitals in Austin, Minnesota, and Albert Lea, Minnesota, from July 1, 2019, to June 30, 2020. The frequency of each CPE was calculated and expressed as the number of CPEs encountered per 100 clinical hours worked. These values were compared between the rural and academic sites.

Results: A total of 33,417 patient encounters over a total of 41,700 resident clinical hours were analyzed between the three study sites. The two settings (rural vs. academic) had significant differences in baseline patient demographics including age, acuity, and admission rates. Several CPEs were found to occur at a higher frequency in the rural hospitals versus the academic hospital: ambulance necessity documentation (9.3/100 h rural vs. 0.07/100 h academic, $p \leq 0.0001$), laceration repair (3.39/100 h rural vs. 2.0/100 h academic, $p = 0.0004$), and splint/cast application (1.53/100 h rural vs. 0.07/100 h academic, $p \leq 0.0001$).

Conclusions: Rural EM rotations provide residents exposure to a variety of valuable educational experiences. These rotations may provide residents with superior exposures to some clinical experiences compared to academic hospitals, particularly out-of-ED transfers and orthopedic procedures. Residency programs without a current rural rotation should consider creating this as an option for their trainees.

Brandon Haefke was affiliated with Mayo Clinic at the time the research study was conducted as a resident physician.

Supervising Editor: Jason Wagner

INTRODUCTION

Emergency medicine (EM) residencies are traditionally hosted at large academic medical centers and usually based at a single hospital. However, many programs are now incorporating clinical experiences at community or rural emergency departments (EDs; experiences collectively called "rural rotations") as part of their curriculum for residents. There are several proposed benefits to rural rotations but the primary benefit is allowing trainees to practice medicine in settings with limited resources and no specialty services.[1] Additionally, it exposes trainees to rural medicine which increases the likelihood of those residents choosing a rural practice setting after graduation.[2,3] Furthermore, several analyses have suggested that rural EDs can have comparable patient volumes to urban hospitals and provide rich training opportunities.[4,5]

Despite the suggested potential of rural rotations, there has been very little research describing the exact nature of the unique clinical experiences these rotations offer to residents. A small study by Wadman et al.[6] (five total residents in the study) suggested that residents on a month-long rural rotation saw similar patient volumes to their academic center with significantly increased rates of exposure to fracture/dislocation reductions and pediatric trauma resuscitations. Another study by Carey et al.[7] compared resident performance of "simple" and "complex" procedures at academic versus rural EDs and found no significant differences in procedural experiences. Other than these small studies, no other data have been published on this topic to date.

The purpose of our study was to characterize the clinical experiences of residents participating in one residency program's required rural rotation and to compare those experiences with their experiences at our tertiary hospital. There was no prespecified hypothesis for this study.

METHODS

Study design and setting

We conducted a retrospective cohort study of all ED patient encounters at Saint Marys Hospital in Rochester, Minnesota, an academic medical center and host site for an EM residency program, as well as two affiliated community hospitals located in Austin, Minnesota, and Albert Lea, Minnesota, from July 1, 2019, to June 30, 2020. Of the two community hospitals, one had an average annual patient volume of approximately 20,000 during the study period and had associated inpatient services. The second had an average annual patient volume of approximately 15,000 and functioned as a stand-alone ED. These two EDs were approximately 40 and 60 min away by ground, respectively, from the nearest tertiary care facility. The tertiary hospital is a large academic hospital with an average annual ED volume of approximately 72,000 and extensive inpatient and subspecialty services.

Participants

Participants were all ED patient encounters within the study period in which any current resident of the Mayo Clinic Emergency Medicine Residency was recorded as a member of the care team in the electronic health record.

Variables

Prior to chart review, a physician panel (consisting of several faculty members and a resident stakeholder) identified a discrete list of procedures and diagnoses that were agreed to reflect the most important educational aspects of community shifts as well as several that were considered to be part of the core skill set of EM.[8] These procedures and diagnoses were compiled into a list and referred to collectively as clinical and procedural experiences (CPEs). A total of 21 CPEs were measured (see Table 2 for a complete list).

Data sources/measurement

All identified patient encounters within the study time frame at the three hospital sites were reviewed for these CPEs. The cumulative frequency of each CPE was recorded. In addition, baseline data of patient age, gender, presenting Emergency Severity Index (ESI),[9] and ultimate disposition from the ED were recorded.

Once these data were collected, the total number of ED shifts worked by residents at the primary teaching hospital and two community hospitals were counted using the residency scheduling software. The total number of CPEs and the total number of shifts were used to calculate how many CPEs, on average, occurred per clinical hours worked. This was ultimately expressed as number of CPEs per 100 clinical hours. Using these data, the number of 12-h clinical shifts needed to predict one CPE was calculated as well.

There were no encounters excluded from any of the three sites. Data were extracted from the charts automatically using SAP Webi, and any encounters in which the data quality was questionable were reviewed manually by BJH. For the encounters at the tertiary hospital, the performing provider listed in the medical record for each procedure was used to identify and remove any procedures performed by non-EM residents or consultants. Prior to gathering data, the research project was submitted to our institutional review board and determined to be exempt. Once these data were collected, they were analyzed using a two-tailed z-test for two proportions. p-values were calculated using an alpha of 0.05.

RESULTS

A total of 1377 patient encounters from the two community hospitals were identified. A total of 32,040 patient encounters from

the tertiary hospital were identified. All patient encounters were included in the study and were analyzed. These results are summarized in Table 1.

The baseline characteristics of patients presenting to the rural sites versus the academic hospital were significantly different. The median patient age was younger in the rural EDs, though notably there was also a higher percentage of octogenarians. Patients presenting to rural EDs were triaged to a lower level of acuity overall and were more likely to be discharged.

Regarding the primary outcome data, these are summarized in Table 2. There were several CPEs that were encountered more frequently during shifts at rural hospitals. The most common CPE in rural hospitals was documentation of ambulance necessity forms (transfer justification documentation), with a frequency of 9.32 experiences per 100 h, or 0.9 shifts to predict one exposure ($p \leq 0.0001$). The second most frequent CPE was documentation of critical care time (4.97 experiences per 100 h, 1.7 shifts to predict one exposure, $p \leq 0.0001$), followed by laceration repair and splint or cast application. At the academic ED, the most commonly encountered CPE was critical care documentation (11.4 per 100 h or 0.73 shifts to predict one exposure, $p \leq 0.001$) followed by trauma evaluation (6.72 per 100 h or 1.24 shifts to predict one exposure, $p \leq 0.001$). Both of these were more commonly encountered at the academic ED versus the rural ED.

There were several CPEs that did not have significantly different rates of exposure between the two EDs, including procedural sedation (0.4 vs.0.55 experiences per 100 h), STEMI diagnosis (0.17 vs. 0.33 experiences per 100 h), endotracheal intubation (0.23 vs. 0.53), and cardiac arrest diagnosis (0.11 vs. 0.38). All of these CPEs trended weakly toward occurring more frequently at the academic hospital.

TABLE 1 Baseline demographics of patients at the two studied training sites.

Baseline characteristics	Rural ED patients ($n = 1337$)	Academic ED patients ($n = 32,040$)	p-value
Age (years)			
0–17	253 (18)	5748 (18)	0.924
18–44	464 (34)	8334 (26)	<0.0001
45–64	264 (19)	7631 (24)	<0.0001
65–84	278 (20)	8163 (26)	<0.0001
85+	118 (9)	2164 (7)	0.002
Sex			
Male	658 (48)	16,156 (50.4)	0.08
Female	719 (52)	15,884 (49.6)	0.08
ESI			
1	15 (1.1)	1004 (3.1)	<0.0001
2	166 (12.1)	6937 (21.7)	<0.0001
3	748 (54.3)	18,845 (58.8)	0.001
4	374 (27.2)	5098 (15.9)	<0.0001
5	68 (4.9)	59 (0.2)	<0.0001
Unspecified	6 (0.4)	97 (0.3)	0.37
Disposition			
Admit	146 (10.6)	13,141 (41)	<0.0001
Transfer	110 (8)	53 (0.2)	<0.0001
OR/cath lab	5 (0.4)	522 (1.6)	<0.0001
Discharge	1101 (80)	18,136 (56.6)	<0.0001
Expired	2 (0.1)	55 (0.2)	0.65
Eloped/LWBS	13 (0.9)	72 (0.2)	<0.0001
Other	0	61 (0.2)	0.01

Note: Data are reported as *n* (%).

Abbreviations: ESI, Estimated Severity Index; LWBS, left without being seen; OR, operating room.

DISCUSSION

In this study describing the clinical experiences of residents during their shifts at two rural EDs in southeast Minnesota, there were several CPEs that were encountered with increased frequency compared to their experience at their main training hospital. Specifically, there were significantly greater exposures to splint applications, fracture reductions, and laceration repairs compared to resident exposures at the academic hospital. In addition, they had frequent opportunities to experience transferring patients to another institution, on average transferring a patient more than once per shift. The high-acuity diagnoses of STEMI and cardiac arrest were not significantly different between the two groups nor were procedural sedations or endotracheal intubations.

The results of this study can be compared to a recent study by Carey et al.,[7] who also compared procedural exposures between academic and rural EDs. Their study showed increased frequency of exposure to procedures in general when residents worked at a large rural ED compared to an academic hospital and similar exposures when working at a small rural ED. Their published data also appear to show increased frequency of fracture reductions and splint application in large rural EDs; however, they analyzed the exposures to procedures summatively rather than individually.

We envisioned this project as a first step to help quantify the value of a rural ED rotation for EM residencies. It showed an increase in exposures to certain CPEs as highlighted. It is important to note that the CPEs themselves can be very different learning experiences in the rural EDs compared to the tertiary care center. For example, reducing a fracture and splinting in a rural ED without an orthopedic team present is a different learning experience that requires a higher level of expertise in the CPE than when the EM resident is assisting the orthopedic team at bedside in the tertiary care center. Another example of a CPE that is very different in the rural ED is trauma evaluations. Level I trauma centers have large teams with multiple physicians and surgeons working together in different roles, including team lead, patient examiner, airway provider, and proceduralists.[10] EM residents caring for patients in this setting only assume one role in this team. In a rural ED, however, the emergency physician often must assume all these roles simultaneously, with minimal ancillary

TABLE 2 Comparative frequency of selected clinical and procedural experiences encountered by EM residents at rural versus academic training locations.

	Rural ED patients		Academic ED patients		
	Experiences/100 h[a]	*N* shifts for one exposure[b]	Experiences/100 h[a]	*N* shifts for one exposure[b]	*p*-value
Clinical/procedural experience					
Ambulance form	9.32	0.9	0.07	118.8	<0.0001
Critical care	4.97	1.7	11.4	0.73	<0.0001
Laceration repair	3.39	2.5	2.0	4.2	0.0004
Splint/cast application	1.53	5.5	0.07	118.8	<0.0001
Trauma evaluation	1.19	7.02	6.72	1.24	<0.0001
Stroke diagnosis	0.68	12.3	1.66	5.01	0.005
Incision & drainage	0.68	12.3	0.2	41.1	0.0002
Fracture reduction	0.4	21	0.17	50.4	0.05
Procedural sedation	0.4	21	0.55	15.1	0.44
Intubation	0.23	37	0.52	15.9	0.13
STEMI diagnosis	0.17	49	0.33	25.6	0.3
Arthrocentesis	0.17	49	0.17	48.9	0.99
Cardiac arrest diagnosis	0.11	73	0.38	22.2	0.11
Complex laceration repair	0.11	73	0.15	57.4	0.73
Lumbar puncture	0.06	147.5	0.26	32.3	0.20
Vaginal delivery	0	—	0.0002	4436	—
Chest tube	0	—	0.11	75.6	0.21
Lateral canthotomy	0	—	0	—	—

[a]The frequency of a given clinical or procedural experience being encountered per 100 clinical hours worked by a resident.

[b]The number of shifts expected to be needed to predict one exposure to a given experience. Assumes a shift length of 12 h.

staff and no surgical services available. The educational differences in these CPEs and others depending on site (rural ED vs. tertiary care center) are difficult to quantify but would benefit from future investigation.

Many rural communities in the United States do not have the benefit of having an EM-trained physician directing their health care in the event of an emergency. A study by Wadman et al.[11] surveying the upper midwest found that only 12% of physicians working in rural EDs were EM residency trained. Another study by Talley et al.[2] has demonstrated that residents attending programs with required rural rotations were significantly more likely to choose a rural practice location after graduation. These studies would suggest that in addition to the potential training benefits, the incorporation of rural rotations may also help alleviate these regional health care discrepancies.

It is also worth mentioning that in addition to the CPEs, there is a considerable amount of clinical learning that can be experienced through rural ED rotations that cannot easily be captured with numbers. This includes the development of decision-making skills and autonomy in the rural ED environment with very limited access to specialist consults. While difficult to quantify, these intangible skills are necessary to become a successful EM provider. We recommend future studies as a next step to explore these benefits.

LIMITATIONS

This study is limited foremost by its scope, focused to a single residency training program and a single geographic location (southeast Minnesota). Other rural EDs may serve patients with different demographics and different baseline prevalence of diseases, leading to different clinical experiences. Additionally, all data in the study were obtained from what was entered in the electronic medical record. We recognize that residents often are informally involved in patient care or procedures beyond what is documented. This may lead to an underrepresentation of the CPE exposure for rural shifts, academic shifts, or both. Finally, this study is both retrospective and observational in nature, meaning causation cannot be established.

CONCLUSIONS

When working shifts in rural EDs, emergency medicine residents have increased exposure to many clinical experiences, most notably management of orthopedic injuries and transferring patients to other institutions. These objective measures are just one aspect

of the many benefits to resident education that rural rotations can offer. Further research would be useful to evaluate other educational aspects of these rotations. Residency programs interested in increasing exposure to certain procedures or clinical encounters should explore the idea of creating this as an option for their trainees.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

ORCID

Brandon Haefke https://orcid.org/0009-0008-4663-9244
Derick Jones https://orcid.org/0000-0001-6638-7293

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How to cite this article: Haefke B, Scholz D, Homme J(, Jones D. Defining the clinical and procedural opportunities available to residents during rural rotations. *AEM Educ Train*. 2023;7:e10922. doi:10.1002/aet2.10922