

## ORIGINAL RESEARCH

## Emergency Medical Services

# Paramedic student encounters with patients during clinical placements: A multi-institutional cohort study

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**Abstract**

**Objective:** Paramedic students in the US are required to complete clinical placements to gain supervised experience with real patient encounters. Given wide variation in clinical placement practices, an evidence-based approach is needed to guide programs in setting realistic and attainable goals for students. This study's goal was to describe patient encounters and hours logged by paramedic students during clinical placements.

**Methods:** A retrospective review of prospectively collected quality assurance data entered by US paramedic students between 2010 and 2014 was conducted. De-identified electronic records entered in the Field Internship Student Data Acquisition Project (FISDAP) Skill Tracker database were included from consenting paramedic students whose records were audited and approved by instructors. Descriptive statistics were calculated.

**Results:** A total of 10,645 students encountered 2,239,027 patients; most encounters occurred in hospital settings ( $n = 1,311,967$ , 59%). The median total number of patient encounters per paramedic student was 206 (142–269) and the median total clinical placement hours per student was 626 (504–752). The median number of team leads per student was 56 (30–84). Students encountered a median of 22 (12–31) pediatric patients, ages 0–12 years, and 181 (126–238) adolescent or adult patients. For pediatric patient encounters, the most common clinical impressions were respiratory distress, other medical complaints, and extremity trauma. Among adult patient encounters, the most common clinical impressions included other medical, trauma, and cardiac conditions.

**Conclusions:** US paramedic students experienced a variable range of patient encounter types and volumes. The findings of this study offer an evidence base from which programs can set realistic and attainable clinical placement requirements.

**KEYWORDS**

educational measurement, emergency medical technicians, internship, residency, program evaluation, retrospective studies

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## 1 | INTRODUCTION

### 1.1 | Background

The public at large expect paramedics to competently perform time-sensitive life-saving care in emergency situations.<sup>1,2</sup> Additionally, employers expect paramedic students to be "work ready" upon entering the workforce.<sup>1,3-7</sup> To meet these expectations, paramedic education programs turn to clinical placements, where students encounter real patients with supervision enabling integration of theory into practice.<sup>8-10</sup> Clinical placements are essential for students to safely begin their practice under the supervision of trained preceptors.<sup>3,4</sup> Yet worldwide, clinical placement resources have been difficult to obtain,<sup>3,11</sup> and there is little empirical evidence available to guide educators in setting realistic and achievable goals for the number and type of patient encounters a student should experience before graduation.<sup>10,12 13-15</sup>

In the United States, paramedic education programs obtain guidance from national emergency medical services (EMS) education standards (NEMSES) and program accreditation standards set forth by the Committee on Accreditation of Educational Programs for the EMS Professions (CoAEMSP).<sup>8,9</sup> In 2020, a total of 641 paramedic programs were CoAEMSP accredited, and 77 additional programs were under review.<sup>16</sup> Current NEMSES, released in 2009 to replace the 1998 US National Standard Curriculum guidelines,<sup>17</sup> do not provide specific patient encounter recommendations and simply reference the CoAEMSP Standards. The CoAEMSP Standards state: "students shall have access to adequate numbers of patients, proportionally distributed by illness, injury, gender, age, and common problems encountered in the delivery of emergency care" (Standard III.A.2, p. 10) There is little guidance on what constitutes "adequate numbers of patients," and before 2015 all encounters were expected to be with real patients in either field or hospital settings.

In 2015, the National Registry of EMTs (NREMT) formally published the Paramedic Psychomotor Competency Portfolio (PPCP) suggesting paramedic students must have sufficient, repeated encounters under the supervision of a trained preceptor to gain entry-level operational proficiency before graduation.<sup>6</sup> In the same year, the CoAEMSP released recommended minimum goals to be reported yearly by accredited programs, known as "Appendix G."<sup>9</sup> Appendix G suggests minimums in age groups and some patient presentations, but programs are permitted to set their own realistic and achievable goals based on the clinical resources in their area. Neither CoAEMSP Appendix G nor the NREMT PPCP prescribes specific requirements related to the frequency and types of patient encounters and guidance related to realistic and achievable goals remains lacking.

Finally, both CoAEMSP Appendix G and the PPCP recommendations formally introduced the option for simulation in lieu of real patient encounters.<sup>9</sup> Thus collectively, CoAEMSP Appendix G and the PPCP represented a major shift in paramedic clinical education in the United States, giving unprecedented flexibility in methods of meeting learning goals. Ideally these simulations should occur before real patient encounters<sup>6</sup> and focus on types of patients that students are

#### The Bottom Line

Clinical exposure is important for paramedic student education and skill development. In this study of data from the Field Internship Student Data Acquisition Project database, 10,645 students reported 2,239,027 patient encounters (median 206 adult and 22 pediatric encounters per student). These findings have important implications for planning paramedic student training.

not likely to see during placements.<sup>9</sup> Empirical data on the quantity and nature of paramedic student clinical placement experiences are therefore needed to inform planning for simulated patient encounters as well as setting achievable goals for clinical placements.

### 1.2 | Importance

To our knowledge, no empirical work has been undertaken that provides a comprehensive description of patient presentations, their age groups, and setting(s) in which US paramedic students participate in such encounters.

A baseline measurement, assessing the frequency and types of patients encountered by paramedic students during clinical placement before the release of the 2015 CoAEMSP Appendix G and PPCP, offers important insight into realistic and achievable patient encounter goals for paramedic students.

### 1.3 | Goals of this investigation

This study sought to describe the nature of patient encounters and quantity of placement hours logged by paramedic students during hospital and field placements before the implementation new CoAEMSP and NREMT recommendations in 2015. Outcomes assessed included encounter setting (hospital vs field), patient presentations, patient ages, and encounters where the paramedic student served as team lead.

## 2 | METHODS

### 2.1 | Study design and setting

Paramedic students used a computerized tracking system (Field Internship Student Data Acquisition Project [FISDAP] skills tracker, Ascend Learning, Minneapolis, MN, USA) for data collection to prospectively report all hospital and field patient encounters during clinical placement. Established in 1997, FISDAP is a web-based software solution used by > 900 EMS programs across the United States. Data from

these programs are maintained in a national de-identified database for research and benchmarking. Details of FSDAP data collection and comparison to other patient care databases have been previously described.<sup>13,18–21</sup>

Instructors at each of the participating training programs verified the data by comparing the computerized records to the preceptor-verified paper evaluations. Successfully verified student records were approved for research by instructors by manually setting a “good data” flag in the database.

An *a priori* decision was made to use only records before the 2015 start of the CoAEMSP’s Appendix G accreditation recommendations and the NREMT PPCP. This study included records for paramedic students who graduated between January 1, 2010 and December 31, 2014.

Institutional review board approval for the prospective collection of paramedic student data were initially obtained from Inver Hills Community College in 1996 and has been renewed annually for 18 consecutive years at that same institution. Additionally, the Ethics Board at Monash University approved this retrospective review (Project number: CF15/4334–2015001870).

## 2.2 | Measurements

The primary outcome of this study was a quantitative description of placement hours, patient types (impressions), and patient age groups encountered by paramedic students in field and hospital settings. For each patient encounter students reported a clinical primary and secondary impression from a list of categories. These impressions represent a out-of-hospital working (presumptive) diagnosis for which the patient was treated. Patient age groups were categorized using the recommended CoAEMSP guidelines as follows: Newborn/Infant (0–1 year), Toddler (2–3 years), Preschoolers (4–5 years), School Age (6–12 years), Adolescent (13–17 years), Adult (18–64 years), and Geriatric (65+ years).<sup>9</sup>

The secondary outcome was the number of encounters where the paramedic student performed as a team leader during field encounters. For each patient encounter students indicated if they had successfully performed as the team leader. The team leadership definition from the NREMT PPCP 2008 draft was used in the software. The NREMT PPCP 2008 draft defined a successful *Team Lead* as a patient encounter where the student:

“Has conducted a comprehensive assessment (not necessarily performed the entire interview or physical exam, but rather been in charge-of the assessment), as well as formulated and implemented a treatment plan for the patient. This means that most (if not all) of the decisions have been made by the student, especially formulating a field impression, directing the treatment, determining patient acuity, disposition, packaging, and moving the patient (if applicable). Minimal to no prompting was needed by the preceptor. No action was initiated/performed that endangered the physical or psychological safety of the patient, bystanders, first responders or crew.”<sup>6</sup>

## 2.3 | Analysis

Inclusion criteria for this analysis consisted of the following: (1) student provided informed consent for research, (2) successful program graduation, and (3) data audit by the instructor was performed and deemed acceptable.

Students with < 10 patient encounters were presumed to have been erroneously marked as audited with good data and excluded from the analysis. Records with missing or invalid age were removed from the age-specific analysis.

Descriptive statistics were calculated. The distribution of all continuous variables was assessed using visual inspection of histograms and measurement of skewness. Skewness of 0.5 or higher was observed and non-parametric statistics are reported. Categorical variables are summarized using frequencies and percentages for categorical variables and medians with interquartile ranges (IQR) are presented for non-normally distributed continuous variables. Analyses were stratified by encounter setting (hospital or field). To account for the potential variability over time, a non-parametric test of trend was used to evaluate for monotonic increase or decrease in the number of patient encounters and hours per student annually throughout the study period. All analyses were performed using STATA 14.2MP (STATA corporation, College Station, Texas, USA).

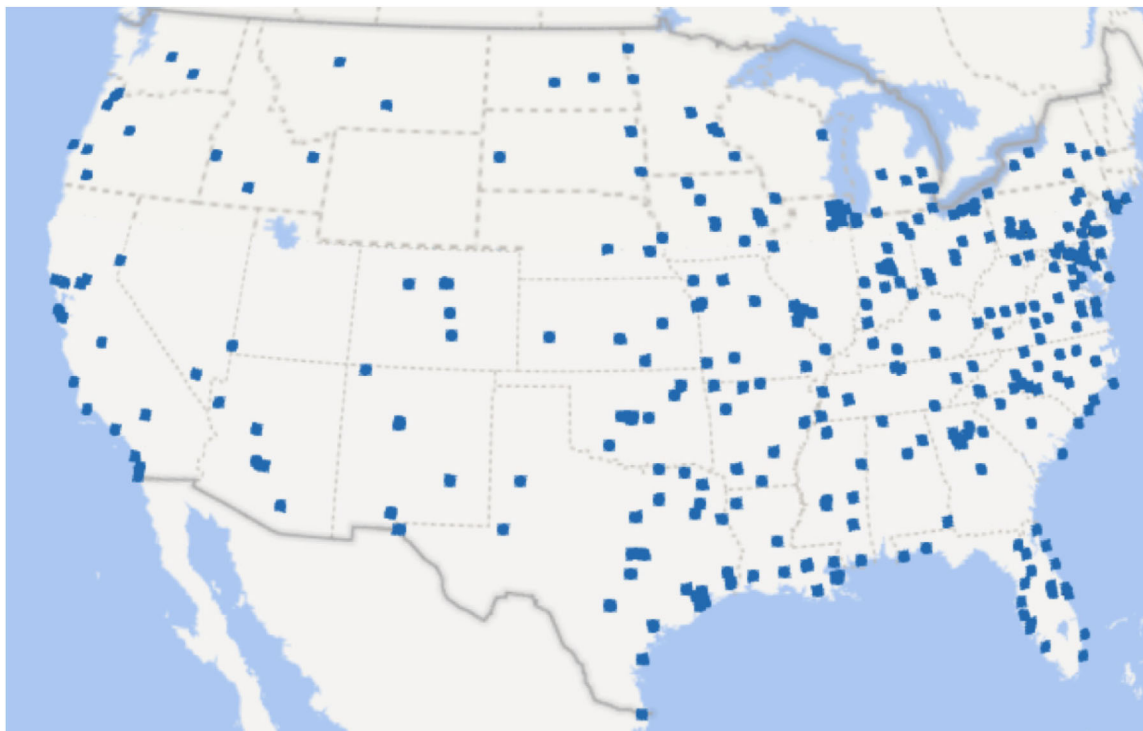
## 3 | RESULTS

A total of 10,721 students provided consent and graduated with instructor approved records during the study period. Of these, 76 students (0.7%) had < 10 patient encounters documented and were excluded. Paramedic students included in the analysis sample were located across the United States. Figure 1 shows the geographical spread of students based on aggregated zip codes of their paramedic program addresses.

### 3.1 | Number of patient encounters, clinical placement hours, and team leads

The 10,645 paramedic students who met all inclusion criteria encountered a total of 2,239,027 patients. Overall, more patient encounters occurred in hospital settings ( $n = 1,311,967$ , 59%), compared to field settings ( $n = 927,060$ , 41%). The median (IQR) number of total patient encounters per paramedic student was 206 (142–269). In hospital settings, students encountered a median of 115 (64–169) patients. In field settings, the median number of patient encounters per student was 77 (53–112). Students spent a median total of 626 (504–752) hours in clinical placements. Median hospital time per student was 234 (170–283) hours and median field time per student was 367 (266–504) hours (Table 1).

From 2010 to 2014, there was a statistically significant increase in the median total number of patient encounters per student from 199



**FIGURE 1** Map of paramedic programs included in this study

**TABLE 1** Number of paramedic student patient encounters and hours by clinical setting (N = 10,645 paramedic students)

Graduation year	Overall		Hospital		Field	
	Encounters Median (IQR) per student	Hours Median (IQR) per student	Encounters Median (IQR) per student	Hours Median (IQR) per student	Encounters Median (IQR) per student	Hours Median (IQR) per student
All years	206 (142–269)	626 (504–752)	116 (64–169)	234 (170–283)	77 (53–112)	367 (266–504)
2010	199 (140–260)	620 (489–728)	108 (58–162)	210 (164–266)	77 (52–116)	371 (264–500)
2011	202 (139–264)	642 (508–754)	112 (61–164)	232 (172–286)	76 (53–112)	364 (266–504)
2012	207 (141–275)	604 (490–741)	117 (64–171)	234 (166–279)	76 (53–110)	354 (262–492)
2013	207 (140–271)	627 (516–763)	116 (65–171)	238 (171–289)	77 (53–110)	372 (278–504)
2014	213 (54–276)	642 (529–775)	126 (78–182)	248 (180–299)	77 (55–108)	375 (276–512)
P-trend	<0.01	<0.01	<0.01	<0.01	0.77	0.06

IQR, interquartile range

(140–260) to 213 (54–276) ( $P$ -trend <0.01). Hospital encounters also increased from a median of 108 (58–162) to 126 (78–182) ( $P$ -trend <0.01); whereas, field encounters remained stable at a median of 77 per student ( $P$ -trend 0.77) (Table 1). The median total hours of clinical placements per paramedic student increased from 626 (504–752) in 2010 to 642 (529–775) in 2014 ( $P$ -trend <0.01).

A total of 663,744 encounters were recorded where the paramedic student was the team lead during field patient encounters. The median number of team leads per student was 56 (30–84). Nearly two-thirds ( $n = 6556$ , 62%) of paramedic students documented 50 or more team leads.

### 3.2 | Encounters by patient age groups

Table 2 describes the number of encounters by patient age group and clinical setting. Overall, paramedic students encountered a median of 22 (12–31) pediatric patients, ages 0–12 years, and 181 (126–238) adolescent or adult patients (older than 12 years). A larger number of pediatric patient encounters occurred in hospital compared to field settings, with a median of 17 (8–26) encounters per student versus 3 (2–6) encounters per student, respectively. Students also encountered more adult patients in hospital settings (median per student: 96 [54–142]) compared to field settings (median per student: 72 [50–105]).

**TABLE 2** Paramedic student encounters by patient age group and clinical setting

Age group, years	All encounters Median (IQR) per student	Hospital Median (IQR) per student	Field Median (IQR) per student
All pediatric (0–12)	22 (12–31)	17 (8–26)	3 (2–6)
N/I: newborn/infant (0–1)	7 (3–12)	5 (2–10)	1 (0–2)
D: Toddler (2–3)	3 (2–6)	3 (1–5)	0 (0–1)
P: Preschooler (4–5)	3 (1–4)	2 (1–4)	0 (0–1)
SA: School age (6–12)	7 (3–11)	5 (2–9)	1 (0–2)
All adolescent/adult (>12)	181 (126–238)	96 (54–142)	72 (50–105)
T: Adolescent (13–17)	7 (4–11)	5 (2–8)	2 (1–4)
A: Adult (18–64)	110 (74–147)	61 (34–92)	40 (27–60)
G: Geriatric (>64)	61 (41–83)	27 (15–43)	29 (19–43)

IQR, interquartile range

Within pediatric patient subgroups, the median number of encounters per student was higher for newborn/infants (median per student: 7 [3–12]) and school age children between 6 and 12 years (median per student: 7 [3–11]). Students encountered a median of 3 (2–6) patients in the toddler age group and 3 (1–4) in the preschooler age group. Within the adolescent and adult patient subgroups, students saw fewer patients in the adolescent category (median per student: 7, [4–11]) and in the geriatric category (median per student: 61 [41–83]) compared to adults ages 18 to 64 (median per student: 110 [74–147]).

### 3.3 | Encounters by clinical impressions

Table 3 shows student encounters by clinical impression and clinical setting for patients ages 0–12 years. The most common clinical impression among pediatric patients was respiratory distress (median encounters per student: 5, [2–9]) and other medical (median encounters per student: 4, [2–8]), followed by extremity trauma (median encounters per student: 2 [0–3]).

Table 4 shows student encounters by clinical impression for adolescent, adult, and geriatric patients (ages >12 years). The most common impressions were “other medical” (median encounters per student: 37, IQR: 22–59), trauma (median encounters per student: 33 [16–50]), cardiac (median encounters per student: 30 [19–41]), respiratory (median encounters per student: 23 [14–33]), abdominal pain (median encounters per student 21 [13–31]), and behavioral-psychiatric (median encounters per student: 13 [6–23]).

### 3.4 | Limitations

This study is limited by the self-reported nature of the patient encounters by paramedic students. Plausibly, students did not record all encounters during field and hospital experience and instead recorded the minimum number of records needed to satisfy program goals or requirements. Thus, the estimates of total encounters and types of encounters reported in this analysis may be conservative. As students

may have focused on documenting minimum contact standards, there is a potential for selection bias with regard to the types of encounters that were recorded in the student logs leading to overrepresentation of less common patient presentations. More common patient presentations may be underreported.

Further, this analysis represents a sample of convenience as not all programs use this database to track their students’ progress. Instructors self-reported their audit of paramedic student data. The accuracy or extent of instructor audits is unknown. Programmatic policies and goals vary, and paramedic students may have reported only what is expected or required of them, rather than every patient encountered during their clinical placements.

Paramedic students were permitted to enter only 2 clinical impressions. It is possible that students reported only those impressions that were required by their programmatic graduation goals. It is also possible that field impressions may not reflect the patient’s admitting or discharge diagnoses.

A large number of contacts with the clinical impression of “Other Medical” was discovered. This general category does not provide the granularity needed to understand the types and frequency of paramedic student exposure to a wide range of medical complaints.

This study was focused on paramedic student encounters before the introduction of the NREMT PPCP and CoAEMSP’s Appendix G recommendations and may appear dated if considered out of context. Including data after December 2014 would introduce variables such as additional laboratory simulation data, goal sets, and dates of implementation for each program that were not available and beyond the scope of this project. The extent to which graduation requirements began shifting real patient encounters to simulation are important factors to consider and should be the subject of continued research.

## 4 | DISCUSSION

The present study provides a description of paramedic student clinical placement experience in terms of encounters with patients in

**TABLE 3** Paramedic student encounters by impression and clinical setting: pediatric patients (0–12 years)

Age group, years	All encounters	Hospital	Field
	Median (IQR) per student	Median (IQR) per student	Median (IQR) per student
Abdominal pain/problems	1 (0–3)	1 (0–3)	0 (0–0)
Allergic reaction	0 (0–1)	0 (0–1)	0 (0–0)
Altered level of consciousness	0 (0–0)	0 (0–0)	0 (0–0)
Behavioral/psychiatric	0 (0–1)	0 (0–0)	0 (0–0)
Burns	0 (0–0)	0 (0–0)	0 (0–0)
Cardiac	0 (0–1)	0 (0–0)	0 (0–0)
Cardiac arrest	0 (0–0)	0 (0–0)	0 (0–0)
Diabetic symptoms	0 (0–0)	0 (0–0)	0 (0–0)
Electrocution	0 (0–0)	0 (0–0)	0 (0–0)
Healthy screening/physical	0 (0–1)	0 (0–1)	0 (0–0)
Hypovolemia/shock	0 (0–0)	0 (0–0)	0 (0–0)
Obvious death	0 (0–0)	0 (0–0)	0 (0–0)
Other medical	4 (2–8)	4 (1–8)	1 (0–1)
Other neurological	0 (0–1)	0 (0–0)	0 (0–0)
Overdose/poison	0 (0–0)	0 (0–0)	0 (0–0)
Respiratory	5 (2–9)	4 (1–8)	1 (0–2)
Seizure	1 (0–2)	0 (0–1)	0 (0–1)
Sepsis/infection	0 (0–2)	0 (0–2)	0 (0–0)
Smoke inhalation	0 (0–0)	0 (0–0)	0 (0–0)
Stings/venomous bites	0 (0–0)	0 (0–0)	0 (0–0)
Stroke/CVA	0 (0–0)	0 (0–0)	0 (0–0)
Syncope/fainting	0 (0–0)	0 (0–0)	0 (0–0)
Trauma-abdominal	0 (0–0)	0 (0–0)	0 (0–0)
Trauma-chest	0 (0–0)	0 (0–0)	0 (0–0)
Trauma-extremities	2 (0–3)	1 (0–3)	0 (0–1)
Trauma-head	1 (0–3)	1 (0–2)	0 (0–1)
Trauma-multisystem	0 (0–1)	0 (0–0)	0 (0–0)
Traum-neck/back	0 (0–1)	0 (0–0)	0 (0–1)

CVA, cerebrovascular accident; IQR, interquartile range

real-world hospital and field settings. This study included a large number of paramedic students from diverse geographic settings. Overall, paramedic students experienced more patient encounters in hospital settings and this was more notable for encounters involving patients under the age of 12. In total, approximately half of students saw < 200 patients during clinical placements. Half of students logged at least 626 clinical placement hours.

These findings provide paramedic educational leaders with national estimates against which to benchmark their program goals. The quantities of encounters involving specific patient presentations offer a base by which minimum goals of achievable experience can be guided. Although local patient volumes and clinical characteristics may vary, this large sample included paramedic students from a wide variety of program types (accredited, non-accredited, higher-education, fire department and hospital based, etc) as well as sites representing rural,

suburban, and urban environments. It is possible that program accreditation status, type of institution, and population density affect the quantity and quality of clinical and field placements. Similarly, experiences in different hospital departments may improve efficiency, such as placing students into a children's hospital emergency department to improve the odds of seeing more pediatric patients. These variations should be a focus for future research.

Access to pediatric patient encounters have long been a problem area for clinical placements.<sup>13,22</sup> In the present study, students saw relatively low numbers of pediatric patients. The current CoAEMSP *Standards and Interpretations* document recommends programs set the minimum contacts for each pediatric subgroup to no < 2 (total of 10).<sup>9</sup> Based on the observed median encounters per student in this study, at least 50% of students would meet these recommendations. Brazelton et al reported paramedic students saw an average of  $24.6 \pm 16.6$



**TABLE 4** Paramedic student encounters by impression and clinical setting: adolescent and adult patients (>12 years)

Age group, years	All encounters Median (IQR) per student	Hospital Median (IQR) per student	Field Median (IQR) per student
Abdominal pain/problems	21 (13–31)	14 (7–22)	6 (3–10)
Allergic reaction	1 (0–3)	1 (0–2)	0 (0–1)
Altered level of consciousness	0 (0–5)	0 (0–1)	0 (0–3)
Behavioral/psychiatric	13 (6–23)	7 (2–14)	5 (2–9)
Burns	0 (0–1)	0 (0–1)	0 (0–0)
Cardiac	30 (19–41)	17 (9–26)	11 (7–17)
Cardiac arrest	2 (1–4)	1 (0–2)	1 (0–2)
Diabetic symptoms	5 (2–7)	1 (0–3)	3 (1–5)
Electrocution	0 (0–0)	0 (0–0)	0 (0–0)
Healthy screening/physical	0 (0–1)	0 (0–0)	0 (0–0)
Hypovolemia/shock	0 (0–0)	0 (0–0)	0 (0–0)
OB-labor	1 (0–3)	1 (0–2)	0 (0–0)
OB-birth cesarean section	0 (0–1)	0 (0–1)	0 (0–0)
OB-birth vaginal	1 (0–2)	1 (0–2)	0 (0–0)
OB-pregnancy problems	2 (1–4)	1 (0–3)	0 (0–1)
Obvious death	0 (0–1)	0 (0–0)	0 (0–1)
Other medical	37 (22–59)	18 (8–33)	17 (9–28)
Other neuro	5 (2–11)	3 (1–6)	2 (1–5)
Overdose/poison	5 (2–9)	2 (0–4)	3 (1–5)
Respiratory	23 (14–33)	12 (6–20)	10 (6–15)
Seizure	4 (2–7)	1 (0–2)	3 (1–5)
Sepsis/infection	4 (1–9)	2 (1–6)	1 (0–3)
Smoke inhalation	0 (0–0)	0 (0–0)	0 (0–0)
Stings/venomous bites	0 (0–0)	0 (0–0)	0 (0–0)
Stroke/CVA	4 (2–7)	2 (0–4)	2 (1–4)
Syncope/fainting	0 (0–3)	0 (0–0)	0 (0–2)
Trauma-abdominal	1 (0–2)	0 (0–1)	0 (0–1)
Trauma-chest	1 (0–3)	1 (0–1)	1 (0–2)
Trauma-extremities	14 (8–21)	7 (3–12)	6 (3–10)
Trauma-head	8 (4–12)	3 (1–6)	4 (2–7)
Trauma-multisystem	3 (1–7)	1 (0–4)	2 (0–4)
Trauma-neck/back	6 (3–9)	2 (1–4)	3 (1–5)

pediatric patients in their clinical rotations and  $5.5 \pm 4.6$  pediatric encounters in the field internship.<sup>23</sup>

Difficulties in agreed-upon standards for evaluation of competency and obtaining paramedic student hospital and field encounters have been reported in the United States and internationally.<sup>3,15,20,24,25</sup> The US paramedic education model has historically adhered to a quantitative model of encounters, requiring numbers of repeated contacts.<sup>6,9,17,26</sup> Multiple observations and positive assessments by trained preceptors certainly improve the validity and reliability of a paramedic student entry-level competence.<sup>27</sup> Seeing enough patients,

however, can be time consuming and costly for students and education programs in low volume areas.

A concerning trend can be noted in the increasing numbers of hours performed in clinical placements. A common number of placement hours cited by paramedic programs ranges from 600 to 1200 hours, based on old national standard curriculum guidelines.<sup>17,28,29</sup> In 2008, Salzman et al reported that graduating paramedic students averaged 347 total hours (mean  $579.6 \pm SD 206.4$ ), and only 7% of students met the recommended guidelines.<sup>30</sup> In the present study students performed a median of 626 (504–752) hours. More research is needed

to determine if students are receiving commensurate academic credit for such increasing hours and potential strategies to decrease hours in favor of higher yield clinical placements.

Moreover, an important and still unanswered question relates to the minimum number of repetitions needed to confidently predict future success when the graduate transitions to independent practice. This becomes problematic if students are seeing low numbers of certain patient types, as this study demonstrates. The number of repetitions needed may also vary depending on the student's ability as well as the acuity and complexity of the patient's condition. Some paramedic students may require more exposure and repetition than others to gain competency, especially in more complex skills such as endotracheal intubation or team leadership.<sup>31–34</sup> A programmatic approach to goal setting should take into account competency as a measurement of consistency and reliability over multiple observations that establish a pattern of future predictive success.<sup>27,35</sup> A pragmatic personalized approach is also needed so that competent paramedic students are not repeating patient contacts, with little additional learning, to simply satisfy one-size-fits-all quantitative requirements.

Numeric goals inherently emphasize quantity, which may compromise quality. Repetition without appropriate feedback, coaching, and valid assessment may not result in graduates who can self-evaluate and seek to improve themselves.<sup>27,36,37</sup> The CoAEMSP annual reporting guidelines before 2015 were based on overall quantities of exposures to patient types where the student performed successful assessments and field team leads.<sup>9</sup> Student observation of others and failed attempts were not counted toward graduation requirements and therefore not necessarily recorded by the students. In the present study we included student exposure to patient types regardless of whether the student indicated they successfully performed the patient assessment and/or the team lead. Here we sought to quantify the potential opportunities for students to assess and treat various types of patient conditions. The degree of participation in patient care, and the degree to which the student successfully performed patient assessment, or the team lead was not considered. The necessary trial and error phase of learning and progressive performance improvement may appear to be deemphasized when goals are simple numbers of successful encounters.<sup>26,27,34</sup> For example, Wilson observed a "eureka" phenomenon when using a graphical method to show progress in paramedic students performing intravenous and endotracheal intubation.<sup>34</sup> The graphing model shows a trial and error phase of learning a varying lengths, then a "eureka moment" where performance markedly improves and success continues. This model shows promise but was evaluated using a sample of 12 ambulance staff. More research is needed to see if the eureka graphing model is a reliable method of determine competency end points and to see if it can be used on other skills.

The area of paramedic student team leader experience has been another key focus of CoAEMSP and NREMT requirements.<sup>6,9</sup> Salzman reported that students who lead more field encounters are more likely to succeed on the NREMT certification exam.<sup>30</sup> The 1998 Paramedic National Standard Curriculum (PNSC) recommended students successfully perform as a team leader 50 times.<sup>17</sup> Salzman et al reported

41% of paramedic students completed 50 successful team leads in 2006, leading the authors to question if this was an attainable goal.<sup>13</sup> In the present study, 62% of graduates in this 2010–2014 sample led 50 or more encounters. Although an increasing number of students seem to have met this goal, the goal may not be attainable for all.

To address team leadership with < 50 patients, the 2015 NREMT PPCP describes Wilson's approach to measuring intravenous and endotracheal skills, but in this case applied to team leadership competence during a capstone field internship.<sup>6</sup> The recommended goal is that paramedic students successfully lead 90% of their capstone field encounters (18 of the final 20 attempts).<sup>6</sup> In one study the students who met this 90%, or 18/20, PPCP goal continued to be successful team leaders, 93% of the time moving forward.<sup>33</sup> More research is needed to validate this model and potentially apply it to other aspects of competency measurement.

Another opportunity for future research is to identify characteristics of field placement settings and perhaps non-quantitative methods that could yield improved benefit to student learning. For example, the use of simulations with standardized patients, global rating scales, and multimedia based learning have shown progress and promise.<sup>34,38–44</sup>

A flexible and multifaceted approach is needed for each individual learner to achieve competency in all aspects of out-of-hospital care. As described in the CoAEMSP Appendix G recommendations, programs need allow for flexibility in the venue where paramedic students obtain experiences (field, clinical, and simulation).<sup>9</sup> If actual emergency patient encounters are not available, simulation may be the most reliable—albeit the least realistic—process by which experience and an assessment of competence can be reliably be obtained.<sup>27,40,43,45</sup> Our findings confirm those of Ernest et al and indicate the CoAEMSP's Appendix G recommended goals are achievable for many students with hospital and field placements alone. The option to add laboratory simulations to meet these goals provides additional flexibility in case some students are not able meet this goal with real patient encounters. Accordingly, educators should set realistic and attainable patient care experience goals while ensuring paramedic students competence.

In summary, graduates of US paramedic education programs experienced a variable range of patient encounter types and volumes. The findings of this study provide a baseline measurement of attainable patient encounters for paramedic students during clinical placements, before the introduction of simulation as a formalized replacement for real patient encounters. Future research is needed to determine a cost-effective and realistic mix of real patient encounters and simulation, as well as the effect that the CoAEMSP and PPCP recommendations have had on US paramedic student competency.

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## CONFLICTS OF INTEREST

David Page is a co-creator of the Field Internship Student Data Acquisition Project (FISDAP). This project transitioned to a commercial



product after grant funding was completed. Mr. Page currently serves as chair of the advisory board, and paid consultant to FSDAP (Ascend Learning, Minneapolis, USA). The research, writing, participation, and work to prepare this study are outside the scope of Mr. Page's consulting agreement and are not compensated or financially supported in any way. Dr. Tom Brazelton serves as a member of the board, and Dr. Gordon Kokx is an employee of the Committee on Accreditation of Educational Programs for the EMS Professions. Dr. Paul Jennings and Dr. Brett Williams declare no conflicts.

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