Original Article

Survey of Emergency Medicine Pharmacy Education Opportunities for Students and Residents

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ABSTRACT

Background: Pharmacy services in the emergency department (ED) have been shown to decrease medication adverse events and improve patient outcomes. Anecdotally, there has been expansion of emergency medicine (EM) educational opportunities for pharmacy students and postgraduate year 1 (PGY1) pharmacy residents, however the extent of this expansion is currently unknown.

Objective: The objective of this survey study is to determine the prevalence and nature of EM pharmacy training available to pharmacy students and residents.

Methods: Electronic surveys were distributed to chairs of departments of pharmacy practice and experiential education representatives at Accreditation Council for Pharmacy Education–accredited colleges or schools of pharmacy as well as residency program directors at American Society of Health-System Pharmacists–accredited postgraduate year 1 (PGY1) programs. Questions were asked related to demographics, EM introductory or advanced pharmacy practice experiences (IPPE or APPE), and PGY1 and non-EM postgraduate year 2 (PGY2) rotations. Five reminder e-mails and weekly and grand prize drawings were offered. Data that were gathered are presented utilizing descriptive statistics.

Results: Overall, 57/110 (52%) colleges or schools of pharmacy representatives and 286/831 (34%) residency program representatives completed the survey. Colleges or schools of pharmacy reported EM IPPEs and APPEs at 12/57 (21.1%) and 44/53 (83%), respectively. EM pharmacy rotations were available for PGY1 and non-EM PGY2 residents at 212/286 (74.1%) and 83/157 (52.9%) of institutions, respectively.

Conclusions: Survey results represent the prevalence and characteristics of EM-related education opportunities for pharmacy students and residents.

Key Words—APPE, emergency medicine, education, IPPE, residency

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Emergency medicine (EM) clinical pharmacy services were first reported in the 1970s and have grown rapidly over the past several years. Following an Institute of Medicine report, the emergency department (ED) was identified as a hospital department with high rates of preventable adverse drug events and was expected to benefit from clinical

pharmacy services.^{1,2} Studies have subsequently shown a relative risk reduction in the number of medication errors when a clinical pharmacist is present in the ED.^{2–6} Furthermore, as the cost of health care continues to be highly scrutinized, the EM pharmacist can provide opportunities for significant cost avoidance.^{2,7,8} The EM pharmacist today is often involved

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in direct patient care including but not limited to resuscitation, medication procurement, and ongoing medication therapy monitoring. Helping meet The Joint Commission standards, the EM pharmacist commonly provides prospective ED medication order review. In addition, EM pharmacists are frequently involved in leadership within the ED through initiatives, education, participation in emergency preparedness, and research and scholarly activities.⁹⁻¹¹

The benefits associated with EM pharmacy services have been repeatedly demonstrated, leading to public, provider, and hospital administrator demands for expansion of this specialized clinical service. This has also led to the development of a position statement and subsequent guidelines pertaining to EM pharmacy services put forth by the American Society of Health-System Pharmacists (ASHP).¹² These ASHP recommendations advocate for the provision of ED pharmacy services, define the responsibilities of the EM pharmacists, and clearly outline their role in the education of health care professionals. Furthermore, ASHP supports the expansion of EM pharmacy educational opportunities specifically for pharmacy students and within postgraduate residency training.^{13,14} This advocacy for expansion of education and training aims to meet the demand for this specialty service. There has been considerable growth of postgraduate year 2 (PGY2) EM pharmacy residency programs during the last several years (there are now 29 ASHP-accredited programs), but this growth alone likely does not meet the demand for EM-trained clinical pharmacists.

Anecdotally, there has been expansion of EM educational opportunities for pharmacy students and postgraduate year 1 (PGY1) pharmacy residents, however the extent of this expansion is currently unknown. To our knowledge, there is only one published article (2003) that describes the quality and quantity of EM pharmacy training available as an elective for pharmacy residents.¹⁰ There are no data currently available describing the EM educational opportunities for pharmacy students. Therefore, to enable the continued provision of safe, effective, and evidence-based care associated with EM pharmacy services, this investigation aims to describe the prevalence and nature of EM pharmacy training currently available to both pharmacy students and residents. These data may identify deficiencies associated with EM pharmacy training and lead to a specific action or education framework that is necessary to develop the competencies and skill sets required to meet the needs of this EM pharmacy specialty.

METHODS

Study Design and Population

This was a survey study designed to collect information regarding the prevalence and nature of EM pharmacy education opportunities available for pharmacy students and residents. Surveys were disseminated to chairs of departments of pharmacy practice (or equivalent) and experiential education directors (or equivalent) at Accreditation Council for Pharmacy Education (ACPE)-accredited colleges or schools of pharmacy to maximize the response rate. A list of ACPE-accredited institutions was obtained from the ACPE Web site (www.acpe-accredit.org); subsequently, each college or school of pharmacy Web site was visited to obtain contact information for the department of pharmacy practice chair (or equivalent) and experiential education director (or equivalent).

In addition, PGY1 pharmacy residency program directors at ASHP-accredited programs were also invited to participate in the study. The contact information for these program directors was obtained from the ASHP Online Residency Directory (<http://accred.ashp.org/aps/pages/directory/residencyProgramSearch.aspx>). The institutional review board approved this study.

Data Collection and Analysis

Two predefined, standardized surveys were developed for dissemination to these 2 groups utilizing SurveyMonkey, a Web-based survey tool (SurveyMonkey Inc., Palo Alto, CA). The survey developed for the representatives of colleges and schools of pharmacy contained questions regarding EM education and rotation opportunities for students only. The survey developed for the PGY1 residency program directors contained questions regarding EM education and rotation opportunities at their institution for pharmacy residents (PGY1 and non-EM PGY2), and it also had the option for representatives to answer questions regarding EM education opportunities at their institution for pharmacy students. The surveys were sent to a small group of pharmacy faculty and staff not directly involved in the study to test the survey instrument for clarity and usability prior to its dissemination to study subjects. Feedback was obtained from the validation period, and surveys were modified based on suggestions received.

On May 13, 2014, surveys were sent via e-mail to the identified colleges and schools of pharmacy and residency program representatives. An information

sheet was displayed as the first screen of the survey to address privacy and security protection and to emphasize the voluntary nature of the survey. No questions were designated as being required, and therefore the number of responses (denominator) for each question or data point varied. Once received, the identified individual had the option of forwarding the survey link to another representative who might be more qualified to complete the survey. The survey contained an identification question regarding the college or school of pharmacy or institution to which the individual was associated in order to facilitate elimination of duplicate responses. After the survey completion deadline (June 13, 2014), the investigators removed any duplicate responses. In the instance of duplicates, the response with the most complete answers was kept for data inclusion. These methods were defined a priori.

Various data were collected, including demographic information such as affiliation with an academic medical center, most recent graduating college or school class size or number of pharmacy residents, and presence of EM-trained faculty or EM clinical pharmacy services. Branching logic was utilized to streamline subsequent survey questions based on previous responses. If the respondent indicated that EM education or training opportunities were available, further questions were displayed inquiring whether the rotation was required or optional, duration of the rotation, rotation activities, and the number of students/residents that completed the opportunity in the past year. These data were gathered for EM-focused introductory pharmacy practice experiences (IPPE), advanced pharmacy practice experiences (APPE), PGY1 rotations, and PGY2 rotations for non-EM PGY2 programs (eg, critical care, internal medicine, infectious diseases). After the deadline for survey completion, data was de-identified, exported to a database (Microsoft Excel, 2011), and analyzed in aggregate. Descriptive statistics were utilized to present the data.

Study Optimization

The survey was open between May 13, 2014, and June 13, 2014 (4.5 weeks). An initial e-mail and 5 reminder e-mails were sent to optimize participation. The reminder e-mails were only sent to representatives who had not completed the survey to date. Additionally, participants could choose to have their names entered into a prize drawing. Each week, contact information of those who had responded were

entered into a spreadsheet separate from the data, and random.org (Randomness and Integrity Services Ltd, Dublin, Ireland) was used to generate a random number based on their line number in the Microsoft Excel (2011) database to identify the winner. Ten gift cards (\$50 each) were awarded to a large online vendor (2 per week). After the survey deadline, 1 grand prize (electronic tablet) was awarded utilizing the same methods as in the weekly drawings. Award winners were contacted within 1 week of study completion.

RESULTS

Respondent Demographics

There were 114 ACPE-accredited colleges or schools of pharmacy identified, with 2 representatives ($n = 228$) from each institution selected as survey recipients as described previously. Two duplicate survey recipients (2 colleges or schools with multiple locations) as well as 6 individuals who had previously opted out of SurveyMonkey e-mails were removed from the survey recipient list prior to dissemination. Therefore, 220 individuals representing 110 colleges or schools of pharmacy were invited to participate in the survey study. There were 65 colleges or schools of pharmacy representatives (59.1%) who responded to the survey, however, 8 were excluded based on duplication. Therefore, a total of 57 survey responses were included in our analysis. Overall, the majority of colleges or schools of pharmacy that were represented ($n = 47$ answered this question) have been in existence for more than 20 years ($n = 33$; 70.2%) and only a small percentage have been in existence for 5 years or less ($n = 1$; 2.1%). Of those who provided their faculty position ($n = 47$), 22 (46.8%) were chairs of the department of pharmacy practice (or equivalent) and 25 (53.2%) were involved in experiential education. Full-time faculty members ($\geq 50\%$ of their salary from the college or school of pharmacy) with an EM practice site were reported by 11/57 (19.3%) of respondents. Additional demographic information for the respondents is described in Table 1.

There were 864 ASHP-accredited (preliminary, precandidate, candidate, or accredited status) PGY1 pharmacy residency programs identified. Eighteen duplicate residency program directors (from institutions with multiple locations) as well as 15 individuals who had previously opted out of SurveyMonkey e-mails were removed from the survey recipient list. Therefore, the survey was sent to 831 residency program directors. A total of 286 (34.4%) residency programs responded to the survey, and there were

Table 1. Demographic data of survey respondents

Characteristic, <i>n</i> (%)	College or school of pharmacy (<i>n</i> = 47)	PGY1 pharmacy residency program (<i>n</i> = 273)
Academic medical center affiliation	16 (34)	114 (40.3)
Geographic location		
Northeast	9 (19.1)	60 (22)
Northwest	7 (14.9)	24 (8.8)
Midwest	14 (29.9)	91 (33.3)
Southeast	12 (25.5)	63 (23.1)
Southwest	4 (8.5)	33 (12.1)
Other	1 (2.1)	2 (0.7)
Years in existence		
≤5	1 (2.1)	—
6-10	10 (21.3)	—
11-20	3 (6.4)	—
>20	33 (70.2)	—
No. of students in 2014 graduating class		
<50	2 (4.3)	—
50-79	12 (25.5)	—
80-119	13 (27.7)	—
120-149	10 (21.3)	—
150-179	1 (2.1)	—
≥180	9 (19.1)	—
No. of years accredited by ASHP		
Preliminary status	—	1 (0.4)
Pre-candidate status	—	9 (3.3)
Candidate status	—	6 (2.2)
<5	—	66 (24.2)
5-10	—	68 (24.9)
11-15	—	43 (15.7)
>15	—	80 (29.3)

Note: ASHP = American Society of Health-System Pharmacists; PGY1 = postgraduate year 1.

no duplicate responses. Of those who provided their position (*n* = 273), 255 (93.4%) were residency program directors, 13 (4.7%) were EM rotation preceptors, 3 (1.1%) were residency program coordinators, 1 (0.4%) was a medication safety specialist, and 1 (0.4%) was a current PGY1 resident.

In addition to EM education opportunities for residents, 177 (61.8%) of these residency representatives were also able to provide information

regarding student EM education at their institution. Over half of the institutions (175/285; 61.4%) had dedicated (≥4 hours daily) EM clinical pharmacy services. However, only 50/285 (17.5%) programs employed an EM PGY2-trained pharmacist and only 15/281 (5.3%) institutions had PGY2 EM pharmacy residency programs. Additional demographic information for the respondents is described in **Table 1**.

Pharmacy Student Training Opportunities

There were 12/57 (21.1%) colleges or schools of pharmacy who offered an EM IPPE for students. One of these requires all students to participate in the EM IPPE (~100 students completed in the past year). A full-time faculty member with an EM practice site is also employed at 5/12 (41.7%) colleges or schools of pharmacy that offer an EM IPPE. The majority of colleges or schools of pharmacy that offered an EM IPPE had well-established programs, with 8 (66.7%) having more than 20 years in existence.

As mentioned previously, PGY1 residency program directors had the option of answering pharmacy student EM education opportunity questions. Of the 177 PGY1 pharmacy residency program respondents who provided information regarding students, 38/172 (22.1%) reported offering an EM IPPE for pharmacy students. These colleges or schools of pharmacy ($n = 9$) and PGY1 pharmacy residency respondents ($n = 37$) reported an affiliation with an academic medical center in 22/46 (47.8%) cases. The majority of EM IPPE opportunities described by these 2 groups had only been offered for a short time, with 86.4% existing for less than 5 years. The IPPE opportunities for students were located primarily in the Midwest (43.5%) and Southeast (26.1%). Jointly, these respondents provide a variety of EM educational activities for IPPE students (Table 2). College or school of pharmacy representatives reported that 170 students (median, 5; interquartile range [IQR], 3-8) completed an EM IPPE in the past year and residency program representatives reported 153 students (median, 4; IQR, 3-6) completed an IPPE in the past year. These numbers likely represent duplication, as there was no way to take into account which respondent colleges or schools of pharmacy are affiliated with which respondent institutions.

EM APPE opportunities were reported by 44/53 (83%) colleges or schools of pharmacy. One of these institutions required this rotation for all students (~50 students completed in the past year). This was not the same college or school of pharmacy that required the EM IPPE rotation for all students. Of the colleges or schools of pharmacy that offer an EM APPE, 10/44 (22.7%) also reported employing a full-time faculty member with an EM practice site. Similar to those institutions offering EM IPPE opportunities, the majority of these institutions reported a long history of training pharmacy students, which was longer than 20 years in existence in 26/39 (66.6%).

A total of 97/173 (56.1%) PGY1 pharmacy residency program respondents reported offering an EM APPE to students at their institution. These colleges or schools of pharmacy ($n = 39$) and PGY1 pharmacy residency respondents ($n = 97$) reported an affiliation with an academic medical center in 63/136 (46.3%) cases. Similar to the EM IPPE opportunities, the majority of EM APPE rotations had been available for a short time, with 70.1% available for less than 5 years and located primarily in the Midwest (33.8%) and Southeast (27.2%). Jointly, these respondents provide a variety of EM educational activities for APPE students (Table 2). College or school of pharmacy representatives reported 402 students (median, 6; IQR, 4-11.5) completed an EM APPE in the past year, and residency program representatives reported 540 students (median, 4; IQR, 2-7) completed an APPE in the past year. As mentioned previously, these numbers likely represent duplication, as there was no way to take into account which respondent colleges or schools of pharmacy are affiliated with which respondent institutions.

EM-related topics were reported as being included in the didactic therapeutics curriculum at 7/46 (15.2%) colleges or schools of pharmacy and occurring at various stages of training. Three institutions reported incorporating EM topics during professional year (PY) 2, 3 during PY3, and 1 during both PY2 and PY3. A full-time faculty member with an EM practice site was also employed at 3/7 (42.9%) of the institutions that offered EM topics in the therapeutics curriculum. These institutions were generally long-standing; 5/7 (71.4%) were in existence for longer than 20 years.

Only 4/47 (8.5%) colleges or schools of pharmacy reported an EM didactic elective course that was available to students. There were a variety of EM topics reported to be covered during the elective courses, including anaphylaxis, antibiotics, electrolyte emergencies, thromboembolic emergencies, and toxicology, as well as several time-dependent emergencies such as acute ischemic stroke, cardiac arrest, sepsis resuscitation, and trauma resuscitation. A total of 140 students completed these electives in the previous year, with a class size ranging from 15 to 70 students. These courses were offered to students during PY2 at 1 institution while the remaining 3 were offered during PY3. Similar to institutions with an EM section of their therapeutics curriculum, the majority of institutions who offered an EM didactic elective are long-standing; 3/4 (75%) have been in existence for longer than 20 years.

Table 2. Pharmacy student and resident emergency medicine rotation activities^a

Activity, <i>n</i> (%)	IPPE ^b (<i>n</i> =42)	APPE ^b (<i>n</i> =134)	PGY1 (<i>n</i> =210)	Non-EM PGY2 (<i>n</i> =76)
<i>Emergency participation</i>				
Medical resuscitation	27 (64.3)	103 (76.9)	181 (86.2)	73 (96.1)
Stroke response team participation	23 (54.8)	99 (73.9)	165 (78.6)	64 (84.2)
Myocardial infarction team participation	23 (54.8)	94 (70.1)	149 (71)	61 (80.3)
Trauma resuscitation	18 (42.9)	80 (59.7)	137 (65.2)	61 (80.3)
<i>Consultative services</i>				
Drug information	37 (88.1)	125 (93.3)	193 (91.9)	75 (98.7)
Drug therapy recommendations ^c	30 (71.4)	123 (91.8)	193 (91.9)	75 (98.7)
Renal dose recommendations	29 (69)	117 (87.3)	187 (89)	71 (93.4)
Antimicrobial selection and dose recommendations	27 (64.3)	120 (89.6)	188 (89.5)	74 (97.4)
Medication selection ^d	26 (61.9)	100 (74.6)	178 (84.8)	72 (94.7)
Toxicology	25 (59.5)	94 (70.1)	158 (75.2)	69 (90.8)
Cost-effectiveness recommendations	23 (54.8)	85 (63.4)	156 (74.3)	64 (84.2)
<i>Medication order management</i>				
Allergy screening	31 (73.8)	107 (79.9)	170 (81)	68 (89.5)
Drug interactions screening	29 (69)	104 (77.6)	164 (78.1)	67 (88.2)
Assessment of contraindications to medications	27 (64.3)	105 (78.4)	162 (77.1)	69 (90.8)
Medication therapy monitoring ^c	21 (50)	96 (71.6)	161 (76.7)	73 (96.1)
Prospective review of medications orders	19 (45.2)	68 (50.7)	147 (70)	62 (81.6)
Medication preparation and acquisition ^f	17 (40.5)	61 (45.5)	124 (59)	56 (73.7)
<i>Adjunct EM pharmacy services</i>				
Medication reconciliation	37 (88.1)	118 (88.1)	173 (82.4)	62 (81.6)
Patient education or counseling	36 (85.7)	120 (89.6)	181 (86.2)	71 (93.4)
Medication-error or adverse drug event reporting	23 (54.8)	86 (64.2)	171 (81.4)	70 (92.1)
Teaching at ED in-services meetings	17 (40.5)	79 (59)	164 (78.1)	69 (90.8)
Microbiological culture follow-up	16 (38.1)	67 (50)	113 (53.8)	53 (69.7)
Emergency preparedness planning	9 (21.4)	28 (20.9)	71 (33.8)	44 (57.9)
EM related research	8 (19)	37 (27.6)	84 (40)	48 (63.2)

Note: APPE = Advanced Pharmacy Practice Experience; ED = emergency department; EM = emergency medicine; IPPE = Introductory Pharmacy Practice Experience; PGY1 = postgraduate year 1; PGY2 = postgraduate year 2.

^aNot all responding programs provided information regarding rotation activities.

^bRepresents combined responses from college or school of pharmacy representatives and residency program representatives.

^cChoice of medication.

^dBased on formulary.

^eFor example, titration of pain medications, sedation, vasopressors, or continuous infusions.

^fIf not located within the ED.

PGY1 Training Opportunities

Overall, 212/286 (74.1%) of the residency program respondents reported offering an EM rotation for their PGY1 residents. The residency class sizes in

institutions that offer this rotation ranged from 1 to 17 (median, 3; IQR, 2-4). EM rotations were required for PGY1 residents at 60/204 (29.4%) institutions. The rotation is usually a concentrated (up to 6 weeks)

rather than longitudinal experience, as reported in 192/203 (94.6%) programs. Eighty-five of the 200 programs (42.5%) that offer an EM rotation to PGY1 residents are affiliated with an academic medical center. Institutions that offer EM rotations for PGY1 residents have been ASHP-accredited for various amounts of time: longer than 15 years in 34% of programs, 11 to 15 years in 14% of programs, 5 to 10 years in 23.5% of programs, less than 5 years in 24% of programs, and 4.5% in the accreditation process. The majority of institutions who offer an EM rotation for PGY1 residents also have dedicated (≥ 4 hours daily) clinical pharmacy services in the ED (165/211; 78.2%), and only 49/211 (23.2%) of these programs reported having a PGY2 EM-trained pharmacist in this role. Rotation activities are described in **Table 2**.

Non-EM PGY2 Training Opportunities

A total of 157/286 (54.9%) residency program representatives reported that their institutions currently have non-EM PGY2 residency programs. Of these, 83/157 (52.9%) had an EM rotation available to their non-EM PGY2 residents. The type of PGY2 programs for which EM rotations are available are described in **Table 3**, and rotation activities are described in **Table 2**. The EM rotation was reported

as required by 38/80 (47.5%) programs, and most rotations were concentrated (85.5% lasting up to 6 weeks) compared to longitudinal. A total of 57% of institutions that offered EM rotations to non-EM PGY2 residents are affiliated with an academic medical center. The majority of institutions that offered an EM rotation for non-EM PGY2 residents also have dedicated (≥ 4 hours daily) clinical pharmacy services in the ED (72/83, 86.7%) and only 30/83 (36.1%) have PGY2 EM-trained pharmacists in this role.

Overall, EM rotation opportunities for both PGY1 and PGY2 non-EM residents have been available for 1 to 2 years at 32.5% of programs, 3 to 5 years at 40% of programs, 6 to 10 years at 21.5% of programs, 11 to 15 years at 4% of programs, and more than 15 years at 2% of programs (200 respondents to this question).

DISCUSSION

Multiple publications have demonstrated the value and perception of the EM clinical pharmacist along with this specialty's rapid growth.^{2-8,11,14} However, only a single study has been published documenting the availability of an EM pharmacy component to residency training, and this study was published over 10 years ago.¹⁰ To our knowledge, there are no historical data available that describe EM pharmacy training available to students.

Thomasset and colleagues¹⁰ first described pharmacy services in the ED in 2003 with a nationwide survey of hospitals with at least 1 ASHP-accredited pharmacy residency program. Of the 259 surveyed hospitals, 119 (45.9%) responses were included in the analysis. A total of 17 (14.3%) reported dedicated pharmacy services in the ED and 43 (36.4%) respondents offered an EM elective rotation. Since the publication of this article, we know anecdotally that there has been an increase in EM education and training opportunities for both students and residents in an effort to meet the demand for this clinical specialty. Our survey study sought to determine the prevalence and nature of EM pharmacy education and training available to both pharmacy students and residents to assess growth since the previously published article.

We found that 21.1% and 83% of colleges or schools of pharmacy reported that an IPPE or APPE was available to pharmacy students, respectively. Similarly, 22.1% and 56.1% of residency program respondents reported having an IPPE or APPE available to pharmacy students at their institution, respectively. An EM elective opportunity was available for PGY1 and non-EM PGY2 residents at 74.1% and 54.9%

Table 3. Non-emergency medicine postgraduate year 2 residencies that offer an emergency medicine pharmacy rotation ($N = 82^a$)

Program	<i>n</i> (%)
Critical Care	54 (65.9)
Infectious Diseases	20 (24.4)
Internal Medicine	15 (18.3)
Ambulatory Care	13 (15.9)
Palliative Care/Pain Management	11 (13.4)
Cardiology	8 (9.8)
Pharmacogenetics	7 (8.5)
Nutrition Support	6 (7.3)
Drug Information	2 (2.4)
Health System Pharmacy Practice Administration	2 (2.4)
Geriatrics	1 (1.2)
Oncology	1 (1.2)
Pharmacotherapy	1 (1.2)
Pharmacy Outcomes/Healthcare Analytics	1 (1.2)

Note: EM = emergency medicine; PGY2 = postgraduate year 2.

^aRespondents could select multiple PGY2 programs

of responding institutions, respectively. This shows that there has been significant growth in available EM training opportunities for residents since 2003.

When available, these EM pharmacy educational opportunities have only existed for a short time. That is, 86.4%, 70.1%, and 72.5% of IPPEs, APPEs, and resident rotations have been available for less than 5 years, respectively. This likely corresponds to the recent growth of EM clinical pharmacy services. As mentioned earlier, data show an increase in pharmacist presence in the ED from 2006 (3.4%) to 2009 (6.8%).¹⁵ Our results suggest that this clinical specialty has continued to grow, as 61.4% of residency program representatives reported dedicated EM clinical pharmacy services at their institution. Although this significant growth may be attributed to the type of institutions (ASHP survey having a more varied sample of hospitals compared to our survey directed at those with residency programs) surveyed, we believe that this still shows that there is likely significant growth.

The prevalence of specific EM rotation activities was evaluated across the spectrum of pharmacy students and residents. A common disparity exists among the majority of EM rotation activities when each successive educational level is compared. IPPE students are provided the fewest EM rotation activities, whereas APPE students and pharmacy residents, especially non-EM PGY2s, are provided a significantly higher number of EM rotation activities. In addition, no single EM rotation activity was offered by all institutions or residency programs that reported providing an EM educational opportunity. These observations are suggestive of significant discrepancies in the training offered by institutions, residency programs, and across each educational level showing that an educational framework may be needed.

Although our survey evaluated numerous activities that may be included in EM rotations for students and residents, there were some activities that respondents described (in free text) that were not evaluated. Educational opportunities including anticoagulation dose optimization and reversal, emergency medical service (EMS) ride-along, and precepting students and residents were additional activities in which students and residents may participate during their EM rotation experience. These additional activities are consistent with the ASHP guidelines on EM pharmacy services.⁹

Diverse clinical pharmacy services are often observed in academic medical centers. These diverse services provide an optimal setting for a broad education in

specialized pharmacy practices. Surprisingly, a reported affiliation with an academic medical center in our study was not associated with a higher percentage of colleges or schools of pharmacy or pharmacy residency programs that provide EM educational opportunities.

Although many institutions may not be able to offer EM rotation activities for students due to lack of EM clinical pharmacy services, EM-trained individuals, or EM faculty, alternatives exist for providing students with didactic exposure to EM topics through therapeutics curriculum or an EM elective. Only 4/47 (8.5%) of respondents reported offering an EM didactic elective to students at their college or school of pharmacy. Additionally, given that only 15.2% of institutions incorporate EM topics into the therapeutics curriculum at their college or school of pharmacy, these opportunities are potentially worthwhile as an alternate method to IPPE or APPE rotations for students and are an underutilized opportunity for providing exposure to EM-related topics.

Colleges or schools of pharmacy infrequently reported employing a full-time faculty member with an EM practice site (19.3%). Although uncommon, institutions possessing such faculty members would intuitively be more likely to provide EM educational opportunities. However, only 41.7% and 22.7% of institutions offering EM IPPEs and APPEs reported also employing a full-time faculty member with an EM practice site, respectively. Similarly, of the institutions teaching EM topics during the didactic therapeutic curriculum, only 42.9% also reported an EM-specific faculty member.

Institutions and residency programs with a long-standing history were more likely to possess EM-specific training opportunities. Furthermore, EM IPPE opportunities were not observed at college or schools of pharmacy with a history of 5 years or less of training pharmacy students and only 1 of these institutions reported an EM APPE. Given the continued expansion in the number of schools or colleges of pharmacy and pharmacy residency programs, the development of curricula, practice sites, and clinical services is an ongoing process.¹⁶ As this development continues, the number and type of EM educational opportunities will evolve, as observed in our study.

Limitations

These data are not without limitations. First, the response rate associated with a survey study is an expected limitation. However, our response rates are consistent with the reported average response rates for studies that utilized data collected from individu-

als ($52.7\% \pm 20.4$).¹⁷ We did attempt to improve our response rate with several reminder e-mails throughout the survey study time period, and we also offered a weekly and grand prize to encourage participation.

Another limitation is the identification of the correct, most knowledgeable (regarding EM education opportunities) individual to receive the survey. To minimize this limitation, we sent the survey to 2 individuals in the colleges and schools of pharmacy and offered all survey recipients the opportunity to forward the survey to a representative who they felt was most qualified to answer the survey questions. However, there is still the possibility that the knowledge of the individual completing the survey is a limiting factor, and this must be considered when interpreting the results of this study.

Because 2 individuals were allowed to complete the survey from each identified college or school of pharmacy, there was the possibility of duplicate responses from a single institution. We addressed this by creating methods for handling duplicate responses a priori. However, some duplicates may remain, as respondents voluntarily identified or omitted their institution information. Furthermore, college or school of pharmacy as well as residency program representatives supplied information regarding education opportunities for students. As mentioned previously, we were not able to determine which college or school of pharmacy respondents may have been affiliated with which respondent institutions. Therefore, duplicate responses may have been provided regarding the educational opportunities available for pharmacy students, however we made an effort to report results separately to avoid grossly overestimating the total number of students with EM education opportunities.

Furthermore, there are likely health care institutions that offer EM rotation opportunities for students but were not invited to participate in the survey as they lack a pharmacy residency program, a characteristic necessary for identification as a potential survey candidate. Therefore, the data representing student opportunities at an institution (reported by pharmacy residency representatives in our study) may be an underestimate.

Lastly, there are 2 possibilities that may correspond to under- or overrepresentation of EM education opportunities. There is likely information that has been omitted regarding both student and resident opportunities, as only 15 institutions with a PGY2 EM pharmacy residency program responded to the survey. At the time of survey dissemination,

there were 21 programs listed on the ASHP Online Residency Directory with an available PGY2 EM residency. Assuming these residency programs have educational opportunities for PGY1 pharmacy residents and pharmacy students, the data we present may be an underrepresentation of the opportunities potentially available. Conversely, an overrepresentation may be possible, as individuals with an interest in EM or with EM services or education opportunities already in place may be more likely to respond to an EM-focused survey.

Conclusion

We were able to determine the current prevalence and nature of EM education for pharmacy students and residents. These survey responses are able to represent baseline data for pharmacy students and show an increase in EM education opportunities for residents over the past 10 years. Furthermore, this study reveals that there is a need for the development and standardization of education and rotation opportunities for pharmacy students and residents to continue to meet the growing need of this clinical specialty.

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